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NAVAL POSTGRADUATE SCHOOL

Monterey, California



THESIS

AN ANALYSIS OF DATA VALIDITY
FOR MEASURES OF
EFFECTIVENESS OF INFORMATION SYSTEMS

by

Gregory M. Regens

March 1991

Thesis Advisor:

William J. Haga

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T254715

REPORT DOCUMENTATION PAGE

1a. REPORT SECURITY CLASSIFICATION UNCLASSIFIED			1b. RESTRICTIVE MARKINGS		
2a. SECURITY CLASSIFICATION AUTHORITY			3. DISTRIBUTION/AVAILABILITY OF REPORT Approved for public release; distribution is unlimited.		
2b. DECLASSIFICATION/DOWNGRADING SCHEDULE					
4. PERFORMING ORGANIZATION REPORT NUMBER(S)			5. MONITORING ORGANIZATION REPORT NUMBER(S)		
6a. NAME OF PERFORMING ORGANIZATION Naval Postgraduate School		6b. OFFICE SYMBOL (If applicable) 37		7a. NAME OF MONITORING ORGANIZATION Naval Postgraduate School	
6c. ADDRESS (City, State, and ZIP Code) Monterey, CA 93943-5000			7b. ADDRESS (City, State, and ZIP Code) Monterey, CA 93943-5000		
8a. NAME OF FUNDING/SPONSORING ORGANIZATION		8b. OFFICE SYMBOL (If applicable)		9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER	
8c. ADDRESS (City, State, and ZIP Code)			10. SOURCE OF FUNDING NUMBERS		
			Program Element No.	Project No.	Task No.
					Work Unit Accession Number
11. TITLE (Include Security Classification) AN ANALYSIS OF DATA VALIDITY FOR MEASURES OF EFFECTIVENESS OF INFORMATION SYSTEMS					
12. PERSONAL AUTHOR(S) Regens, Gregory M.					
13a. TYPE OF REPORT Master's Thesis		13b. TIME COVERED From To		14. DATE OF REPORT (year, month, day) March 1991	
				15. PAGE COUNT 166	
16. SUPPLEMENTARY NOTATION The views expressed in this thesis are those of the author and do not reflect the official policy or position of the Department of Defense or the U.S. Government.					
17. COSATI CODES			18. SUBJECT TERMS (continue on reverse if necessary and identify by block number)		
FIELD	GROUP	SUBGROUP	data collection, effectiveness, evaluation, information systems, validity		
19. ABSTRACT (continue on reverse if necessary and identify by block number)					
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20. DISTRIBUTION/AVAILABILITY OF ABSTRACT <input checked="" type="checkbox"/> UNCLASSIFIED/UNLIMITED <input type="checkbox"/> SAME AS REPORT <input type="checkbox"/> DTIC USERS			21. ABSTRACT SECURITY CLASSIFICATION Unclassified		
22a. NAME OF RESPONSIBLE INDIVIDUAL William J. Haga			22b. TELEPHONE (Include Area code) (408) 646-1276		22c. OFFICE SYMBOL AS/HG

Approved for public release; distribution is unlimited

An Analysis of Data Validity
for Measures of
Effectiveness of Information Systems

by

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Captain, United States Army
B.S., University of Arizona, 1981

Submitted in partial fulfillment
of the requirements for the degree of

MASTER OF SCIENCE IN INFORMATION SYSTEMS MANAGEMENT

from the

NAVAL POSTGRADUATE SCHOOL
March 1991

ABSTRACT

This thesis examines validity issues associated with the use of data collection techniques in information systems research. It presents an analysis of 37 studies that purported to empirically assess the effectiveness of information systems. These studies were evaluated to determine the validity of measures of effectiveness of information systems. Each study was reviewed to identify (1) data collection techniques used, (2) purported measures of the techniques, (3) ways in which the techniques were administered, and (4) discussions of validity issues arising from the use of the techniques.

Findings indicate that information systems researchers have adopted data collection techniques commonly used by social scientists; however, they largely ignore or are unaware of associated validity issues. Over three-quarter of the studies involved questionnaires and fewer than a quarter addressed validity issues. Consequently, the credibility of information systems research is vulnerable to challenge.

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ACKNOWLEDGEMENTS

I extend my sincere appreciation and gratitude to Professor William J. Haga. His guidance and patience proved invaluable throughout the past year. I am also grateful for the assistance provided by Professor Frank J. Barrett, as second reader. I wish to recognize the efforts of M. Agus Mustofa, whose research served as an impetus for this thesis. (Mustofa, 1989) Finally, my warmest thanks are given to my wife, Barbara. She provided unwavering support during the challenging months of study. Barbara's love, devotion, and selflessness eased my academic burdens, propelled me forward, and enriched my life.

I. INTRODUCTION

A. THE MOTIVATION TO ACCURATELY MEASURE THE EFFECTIVENESS OF INFORMATION SYSTEMS

After spending billions of dollars on automating the offices of white collar workers, organizations find that they must scrutinize the claims by computer vendors about increased productivity. To prudently manage a resource an organization must have a means to measure its benefits as well as its costs.

An appropriate managerial question that arises is whether an organization is getting a return on its investment in a resource. This necessity is not diminished because the resource in question is an information system. Managers of information systems are pressed by senior line management to answer, again and again, the question, "What is the value of the company's investment in information systems?" (Matlin, 1979).

According to Strassman (1976), "Industries and governments all over the world are currently struggling to contain rising administrative and clerical overheads by automating information handling in the office."

While the clerical work force has been the fastest growing segment of the labor force in nearly every industrialized country since the 1960s, the productivity of

this sector has been flat since the early 1970s (Harris, 1987). This has been the result despite the fact that 40% of capital spending (in the United States) has been directed at information technology.

General managers in the United States, when surveyed by the University of Minnesota Management Information Systems Research Center, ranked the measuring of system effectiveness as the fourth most critical problem they face in managing information systems (Brancheau and Wetherbe, 1987). Sixty percent of the management information systems executives polled in the same survey placed the measuring of effectiveness in their "top ten" list of critical problems. The assessment of system success has been in the top ten list of critical management information systems problems since it was first formulated in 1980.

Information systems practitioners are clearly expressing considerable concern over the effectiveness of information systems. Consequently, researchers are devoting considerable efforts to studying effectiveness of systems. Professional journals routinely publish articles reporting researchers' findings concerning effectiveness of information systems; however, are these findings based upon measures that have demonstrated validity?

B. ARE RESEARCHERS ADDRESSING VALIDITY ISSUES?

Evaluations regarding the effectiveness of information systems are based upon measures collected and analyzed by

information systems researchers. Such measures are gathered using a variety of data collection techniques. Researchers in sociology, such as Campbell and Stanley, Denzin, Phillips and Suchman, have demonstrated that data collection techniques significantly influence data validity.

C. THE RESEARCH QUESTION

This study asks if information systems researchers, who reported measures of information systems effectiveness, sufficiently addressed validity issues arising from data collection techniques.

Subsidiary research questions follow:

1. What data collection instruments do researchers use?
2. What do researchers purport to measure with the instruments?
3. How do researchers administer the instruments?
4. How and to what extent do researchers address validity issues?

Using these research questions, the study will assess the general awareness and sensitivity of researchers to validity issues.

D. SCOPE OF THE STUDY

This study consists of an analysis of published empirical methods, since 1970, which were used to evaluate effectiveness of information systems. The analysis identifies how researchers collected data when evaluating the effectiveness of information systems and how they subsequently addressed validity issues. Using literature

from sociology, the data collection techniques used by information systems researchers are examined and their impact upon data validity is discussed.

E. ASSUMPTIONS

It is assumed that the 37 articles analyzed in this study represent the current state of information systems research. Findings regarding the researchers who wrote these articles are assumed to apply to information systems researchers in general.

F. ORGANIZATION OF THE STUDY

This study is organized into introduction, literature review, methodology, findings, and conclusions chapters. The literature review chapter explains the concept of validity, drawing primarily upon works of prominent social scientists. The methodology chapter details the selection of studies for review and the methods in which these studies were analyzed. The findings chapter presents data collected during the analysis of 37 articles regarding effectiveness of systems. The conclusions chapter discusses the significance of key findings and provides recommendations for enhancing the credibility of information systems research.

II. LITERATURE REVIEW

A. CLASSICAL DEFINITION OF MEASUREMENT

Stevens (1951) provides a popular definition of measurement, "Measurement is the assignment of numbers to objects or events according to rules." This definition is appropriate for the physical sciences, where the objects and events are the focus of research. Information systems researchers often measure phenomena which are typically too abstract for characterization as either objects or events. Information systems researchers are currently studying issues of effectiveness, benefit, and success of information systems. All of these issues are too abstract for direct observation and quantification.

B. MEASUREMENT AND THE SOCIAL SCIENCES

Social science researchers study phenomena which are equally abstract. They have adopted an alternative definition of measurement, as suggested by Blalock (1968),

"Sociological theorists often use concepts that are formulated at rather high levels of abstraction. These are quite different from the variables that are the stock-in-trade of empirical sociologists. . . . The problem of bridging the gap between theory and research is then seen as one of measurement error."

Carmines and Zeller (1979) view measurement most usefully as the process of linking abstract concepts to empirical indicators.

Carmines and Zeller's definition of measurement in social science research identifies a process that involves both theoretical as well as empirical considerations. They further elaborate,

"From an empirical standpoint, the focus is on the *observable response*--whether it takes the form of a mark on a self-administered questionnaire, the behavior recorded in an observational study, or the answer given to an interviewer. Theoretically, interest lies in the *underlying unobservable* (and directly unmeasurable) concept that is represented by the response. . . . Measurement focuses on the crucial relationship between the empirically grounded indicator(s)--that is, the observable response--and the underlying unobservable concept(s)."

C. MEASUREMENT AND INFORMATION SYSTEMS

To deal with the abstract nature of information systems issues, many information systems researchers are using the measurement process and data collection techniques commonly found in social science. Information systems researchers often use observable response, unobservable concepts, and linking relationships to measure information systems phenomena. Figure 1 illustrates how the measurement process used by many information systems researchers mirrors the measurement process used in social science. Consequently, these information systems researchers have, consciously or unconsciously, adopted the measurement process of social science.

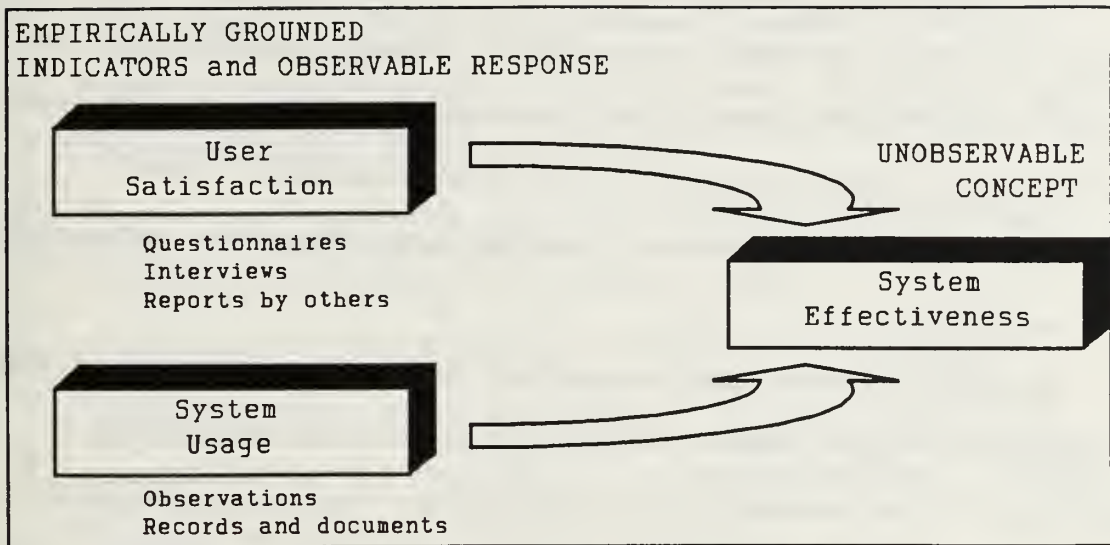


FIGURE 1. Information Systems' Measurement Process

Social science researchers have long recognized that the validity of the measurement process is critical to deriving useful information from any collected data. Since the same measurement process is now used by information systems researchers, they are now logically subject to the same validity considerations. Information systems researchers who use this form of measurement must understand the concept of validity.

D. CONCEPT OF VALIDITY

Suchman (1967) discusses validity, reliability, their relationship, and its importance. Validity refers to the degree to which any measure or procedure succeeds in doing what it is purported to do. Closely related to validity is the concept of reliability. Reliability refers to the degree to which any measure or procedure can be depended on to secure consistent results upon repeated application.

Validity and reliability are interdependent. There can be no validity without reliability. When a measure is shown to be valid, its reliability is taken for granted. However, one can have high reliability without validity. The demonstration of a measure's reliability does not establish its validity.

Validity is the most important criterion for evaluating a measuring instrument. Every phase of the evaluation process is influenced by its validity. Validity concerns the formulation of objectives, the collection of data, and the interpretation of findings. The validity of an evaluation study refers not only to the validity of its specific criteria or measures, but also to the theory underlying the formulation of the hypotheses concerning the relationship of the activities to the objective.

E. TYPES OF VALIDITY

Phillips (1971) states that to determine the validity of a measuring instrument, one must evaluate it against relevant or appropriate criteria. Social science researchers use numerous criteria to determine the validity of measuring instruments.

The following are types of validity and thus used as criteria to verify the validity of measuring instruments:

1. *Content validity* is the making of a judgement as to the representativeness and comprehensiveness of the measuring instrument's indicators constituting a measurement (Phillips, 1971). Content validity refers to the ability of the instruments to measure what it purports to measure.

2. *Face validity* is an aspect of content validity. It is the extent to which an instrument seems to measure what it is supposed to measure. Face validity is the obvious significance of the measure. It is usually a judgment made by the designer of an instrument, after its completion (Phillips, 1971).
3. *Consensual validity* is a face validity which uses a panel of experts to develop a consensus concerning the validity of a measure (Suchman, 1967).
4. *Criterion or correlational validity* correlates a measure with another indicator that one "knows" measures what is being sought. The new measure is correlated with an existing, accepted measure, thus establishing the validity of the new measure. High correlation of two measures demonstrates the validity of the new measures (Suchman, 1967).
5. *Concurrent validity* is a type of criterion validity that refers to the correlation of a measure and a criterion at the same point in time. For example, correlating data gathered through exit polling interviews to official voting records (Carmines and Zeller, 1979).
6. *Predictive validity* is another type of criterion validity that refers to the correlation of present measures with behavior that is predicted to take place in the future (Suchman, 1967). For example, correlating the results of an undergraduate's SAT scores to his grade point average at graduation.
7. *Construct validity* concerns the degree to which measures conform in accordance with theoretical expectations. Consequently, a theoretical concept must exist for predicting and analyzing the measures. Measures are considered to have construct validity if they are consistent with theoretical expectations. If they are inconsistent with theoretical expectations, then it is concluded that the measures lack validity for that particular concept (Carmines and Zeller, 1979).
8. *Convergent-discriminant validity* is the expectation, based on *a priori* or theoretical grounds, that measures would relate to some other variable or variables. Convergent validity assesses the agreement between different methods of measuring the same construct. Discriminant validity assesses the difference in results when the same method is used to

measure supposedly different attributes of the same object. (Brewer and Collins, 1981)

To establish the validity of measurements, social science researchers verify that the measures correlate with at least one of these types of validity. High correlation to a specific type of validity allows the assignment of that particular type of validity to the measurements. Low correlation to any of the above types of validity fails to establish the validity of the measurements. Expert judgement or empirical procedures serve as the basis for establishing correlation, based upon the type of validity claimed. Cronbach's coefficient alpha, Pearson's product-moment correlations, and Spearman's rank correlations are examples of statistical calculations typically used when establishing correlation through empirical procedures.

F. INTERNAL AND EXTERNAL VALIDITY

The assignment of a type of validity to a given set of measurements, by virtue of the existence of a high degree of correlation to an established type of validity, does not resolve the issue of whether the experimental design accurately measures the phenomena of interest. Further, it doesn't establish whether the study findings can be legitimately extended beyond the sample. These issues are directly addressed as the concepts of internal and external validity. The existence of internal and external validity establishes the meaningfulness of an experimental design far

more than does the assignment of a type of validity to a given measurement.

Campbell and Stanley (1966) define internal validity as dealing with the issue of whether the measurements are due to the effect of a particular independent variable or causally related to the dependent variable of interest. It asks whether a difference exists at all in any given comparison or if an observed difference is an artifact of the observational process. Internal validity provides assurances that the measurements from a research design result from its identified variables. When the measurements are causally related to the dependent variable or other factors for which no accounting is made in the research design, the internal validity of the measurements becomes confounded.

Campbell and Stanley (1966) define external validity as the degree to which findings can be generalized to larger populations or settings. One uses external validity to project the findings from an experiment beyond its sample, onto some larger population of interest.

G. IMPORTANCE OF INTERNAL VALIDITY

Internal validity is more important than external validity. Measurements from experimental designs that do not have internal validity are considered unreliable and unrepresentative of the phenomena of interest. Consequently, it is impossible to extend a study's findings

beyond the sample population. Internal and external validity are interdependent. Without internal validity, an experimental design can not have external validity. The existence of internal validity does not insure that the experimental design will possess external validity.

H. FACTORS THREATENING INTERNAL VALIDITY

Campbell and Stanley (1966) identify 12 factors jeopardizing the internal or external validity of experimental designs. Relevant to internal validity, they present eight factors, which if not controlled in the research design, might result in effects that obscure the effect of the experimental stimulus. Some of these factors threatening internal validity deal with spurious conclusions based upon observations made before and after the effect of an intervening experimental variable. Others deal with erroneous conclusions based upon supposed differences between comparison groups. The following factors potentially threaten the internal validity of experimental designs:

1. *History*, the external events occurring between the pretest measurements and post-test measurements in addition to the experimental variable.
2. *Maturation*, refers to the process of change within the respondents themselves as a function of the passage of time.
3. *Testing*, the effects resulting from having taken earlier tests, commonly referred to as re-test sophistication.
4. *Instrumentation*, the changes occurring in the calibration of the measuring instruments, observers,

or scorers produces changes in the observed measurements.

5. *Statistical regression*, where groups have been selected on the basis of their extreme scores. Measures of such groups tend to regress towards the mean on subsequent observations.
6. *Selection biases*, is the differential selection of respondents for the sample population.
7. *Experimental mortality*, is the non-random drop-out of participants from the experiment.
8. *Selection-maturation interaction*, in multi-group designs, their interaction is confounded with the effect of the experimental variable.

I. FACTORS THREATENING EXTERNAL VALIDITY

Campbell and Stanley (1966) presents four factors that can jeopardize external validity or representativeness. If not controlled in the research design, these factors might result in the inappropriate generalization of study results to larger populations. These factors are (1) the reactive or interactive effect of testing, (2) the interaction effects of selection biases and the experimental variable, (3) reactive effects of experimental arrangements, and (4) multiple-treatment inference.

Bernstein et al. (1975) elaborated on the works of Campbell and Stanley (1966) and Bracht and Glass (1968), regarding factors that threaten external validity of research findings. They have grouped these factors into the following categories:

1. *Selection effects* result from infeasibility of drawing a probability sample from the target population. Instead the researcher must sometimes use a biased sample. The types of such selection biases, in order

of the degree to which they threaten external validity, are (1) self-selection by the respondents into treatment and control groups, (2) selection by excellence, (3) selection by expedience, and (4) non-random posttreatment matching.

2. *Measurement effects* includes the effects of unreliability and invalidity of measurement, the reactivity of some measures, and interactions between measurement and other variables.
3. *Confounded treatment effects* may arise when (1) a lack of standard treatments are applied across sampling elements, (2) multiple treatments are applied across sampling elements, or (3) individual level variables (attributes) of the sampling elements interact with the treatments.
4. *Situational effects* result from the conduct of the experiment in a particular context that is not representative of all contexts to which the researcher may wish to extend a generalization.
5. *Effects due to differential mortality* result from differential subject and program losses during social experiments. When the losses are different for the treatment and control groups, and these losses are not random, then external validity is threatened.

J. DATA COLLECTION TECHNIQUES

Galtung (1967) states that all social science data are obtained in either formal (laboratory) or informal (field) settings and involve either verbal (oral and written) or nonverbal acts or responses. The combination of the two settings for data collection and two ways responses are exhibited have led to the development of these commonly used data collection techniques:

1. Observations of behavior
2. Experiments
3. Reports by others
4. Analyses of existing records and documents

5. Interviews

6. Questionnaires.

Each data collection technique has its own characteristics and resulting impacts upon validity.

1. Observations of Behavior

There are primarily three forms of collecting observations of behavior:

1. Simple observation
2. Contrived observation
3. Participant observation.

Simple observation of behavior involves an observer who has no control over the behavior or situation in question, and plays an unobserved, passive and unobtrusive role in the research situation (Webb et al., 1966). Denzin (1970) identifies five types of simple observations: exterior body and physical signs, expressive movement, physical location analysis, observation of language, and time sampling analysis.

Denzin (1970) identifies sources of invalidity with simple observation. Populations change over time and location, making it very difficult to gather representative samples. Small samples of much larger populations may result in quite tentative generalizations. Observers or measuring devices make errors. Some types of behavior occur usually under conditions that are very difficult to observe, for example covert or illicit acts. Finally, unless prior

investigations are conducted, it is very difficult to position observers in settings where critical behavior occurs at a high frequencies.

Contrived observation substitutes the human record-keeping observers present in simple observation with hardware devices (Webb et al., 1966). Hardware devices are substituted for humans as means of avoiding human instrument error and supplementing control of the experiment. It is an unobtrusive form of data collection, employing devices such as hidden video cameras, mirrors, and audio recorders. Measurements obtained through the use of contrived observations share the same sources of threats to validity as measurements obtained through the use of simple observation.

Participant observation of behavior is a field strategy that simultaneously combines document analysis, respondent and informant interviewing, direct participation and observation, and introspection (Denzin, 1970). The observer can assume one of four roles.

1. *Complete participant* role is one in which the observer is wholly concealed and he tries to become a full member of the investigated group.
2. *Participant as observer* role is when the investigated group is aware of the identity and intentions of the observer.
3. *Observer as participant* role is one in which investigations usually involve only one visit or interview with the respondent. The interaction is typically brief and highly formalized, using questionnaires or interviews. No attempt is made by the observer to establish a sense of a lasting

relationship with the respondent--the epitome of the stranger encounter.

4. The *complete observer* role involves complete removal of the observer from the interaction. The complete observer role is an unobtrusive method of collecting data, while the other roles are obtrusive.

Denzin (1970) identifies factors regarding participant observation that pose threats to internal validity.

1. *Historical factors* are events that either occurred before observations were made or during the period between the first and last observations.
2. *Subject maturation factors* reflect the changes that occur in respondents, resulting from their relationships with observers.
3. *Subject bias factors* are the nonhomogeneous characteristics of the observed subjects.
4. *Subject mortality factors* reflect the number of subjects who drop-out of or are dropped from the experiment.
5. *Reactive effects of the observer factors* are effects that are created through the introduction of the observer.
6. *Observer changes factors* are effects that are attributed to changes occurring in observers.
7. *Situation factors* are effects caused by peculiar aspects of the situation in which the observations were conducted.

The degree to which the sample selected for observation actually represents larger populations to which study findings are generalized poses concerns of external validity.

2. Experiments

Campbell and Stanley (1966) define experiments as that portion of research in which variables are manipulated in controlled settings and their effects upon other variables observed. Denzin (1970) states,

"In its generic form the experiment represents a situation in which the investigator controls some variables while he manipulates the effects on others. This permits him to observe the effects of the manipulated variables upon the dependent variable in a situation where the effect of other relevant factors is believed to have been removed, typically by randomization."

Experiments are an obtrusive method of data collection.

Figure 2 represents the characteristics of a generic experiment.

	Observed	Exposed to Independent Variable	Observed
Experimental Group	(O) Yes	(X) Yes	(O) Yes
Control Group	(O) Yes	No	(O) Yes

Figure 2. Pretest and Post-test One Control Group Design

As discussed in Chapter II, Sections H and I, Campbell and Stanley (1966) identified 12 factors jeopardizing the internal or external validity of experimental designs. Denzin (1970) argues that the experiment is the model for causal inference from which all other inferential strategies are either derived or to which they are compared. Despite the formidable number of threats

to the validity of experiments, they provide one of the best methods to answer questions of causal inference. The use of experimental methods conveys scientific meaning to a study's findings.

3. Reports by Others

Researchers often use informants to secure reports from others. LeVine (1981) expands on previous works of Campbell to define an informant as normally a member of a group who draws and communicates generalizations from the particularities of his social environment to a researcher. The informant generally possesses superior inductive or verbal skills or has experienced exposure to the phenomena in which the researcher is interested. Denzin (1970) further defines the role of the informant as an unobtrusive *de facto* observer for the researcher, an intimate, a confidant, and a friend. The presence of this kind of binding relationship between the informant and researcher distinguishes an informant from a respondent. LeVine (1981) identifies the informant's biases as this method's primary threat to validity. Informants view their environment from a particular vantage point. This leads inevitably to biased perspective, which poises threats to the internal and external validity of findings derived from measurements obtained through informants.

4. Analyses of Existing Records and Documents

Webb et al., (1966) state analyses of existing records and documents are an unobtrusive method of collecting data. Researchers access archives containing either vocational or scholarly documents and records to obtain relevant data. Computer usage files are an example of archival records.

The selective deposit and selective survival of information in archives can introduce a significant degree of bias, thereby threatening both internal and external validity. Selective survival occurs when existing records and documents are not a representative sampling of the studied population. Selective deposit occurs when records and documents are generated on a non-random basis.

5. Interviews and Questionnaires

An interview is a form of survey study that involves "a face to face verbal interchange in which one person, the interviewer, attempts to elicit information or expressions of opinions or belief from another person (Maccoby and Maccoby, 1954)." Interviews are an obtrusive method of data collection. The basis of all interviews is the questions that are asked. Denzin (1970) comments on interviews, "The questionnaire or interview must serve two broad purposes: it must translate research objectives into specific questions, the answers to which will provide data necessary for hypothesis testing, and it must assist the interviewer

in motivating the respondent so that the necessary information is given." An interview is conducted in one of three forms:

1. Schedule standardized
2. Nonschedule standardized
3. Nonstandardized.

The schedule standardized interview involves wording and ordering all questions exactly the same for all respondents, thus using a uniform measuring instrument. It must be assumed that the questions mean the same thing to all respondents. Granting that all questions are comparable, any variations between respondents are attributed to actual differences in the response, not the measuring instrument (Denzin, 1970).

The nonschedule standardized interview involves the interviewer working with a standard list of the information required from each respondent, but ordering and phrasing the questions in such a manner as to best gather the information. This allows the interviewer to partially tailor the interview to the individual characteristics of each respondent. Modification of the interview requires a highly skilled interviewer. Granting that the interviewer succeeds in asking comparable questions to all respondents during such nonschedule standardized interviews, any differences are attributed to actual variances in response, not the measuring instrument (Denzin, 1970).

The nonstandardized interview does not use a pre-specified set of questions nor are questions asked in a specific order. This allows the interviewer complete freedom to explore any issues that arise during the course of the interview. It is clearly recognized that respondents are not presented with a comparable set of questions (Denzin, 1970).

A questionnaire is another form of survey study that is quite similar to a scheduled standardized interview. Questionnaires, like an interview, attempt to elicit information or expressions of opinions or belief from another person or persons. They differ from the interview in that the interchange is not verbal. The interchange most commonly occurs in the form of written questions and answers. Questionnaires are an obtrusive method of data collection.

Denzin (1970) declares that all types of interviews and questionnaires share common deficiencies. First, researchers relying on interviews and questionnaires can experience difficulties penetrating the respondent's group language and mechanisms of symbolism. When failure is experienced, they often ask questions concerning what is on the mind of the researcher, rather than what is on the mind of the respondent.

Second, errors arise from respondents not always interchanging honestly with the interviewer during the

conduct of an interview or completion of a questionnaire. A variation of this deficiency can occur when questionnaires are mailed to targeted respondents. Persons other than the targeted respondent can complete mailed questionnaires, assuming the identity of targeted respondents. Researchers typically assume that questionnaires are completed by the targeted respondent, since they possess little means of knowing who actually completes questionnaires.

Third, respondents occupy different positions within their own groups, and hence have their own interpretations and even distortions of what are the actual group's values. Each of these commonly shared deficiencies potentially threaten the internal and external validity of measurements when using the interview as a data collection technique.

6. Physical Traces

Webb, et. al. (1966) discussed an unobtrusive data collection technique that is based on the study of physical traces. Researchers analyze physical traces and signs that were left behind by a population. The producers of the physical traces and signs are unaware of their future use by researchers. There are two basic types of physical traces: erosion measures and accretion measures.

Erosion measures are remains of some population's activities that have selectively worn certain objects. The path worn on a tile floor is an example of an erosion measure. Erosion measures are susceptible to biases

resulting from the physical composition of materials in which the traces are recorded.

Accretion measures are the recording of population deposits over time. The cigarette butts deposited in an ash tray are an example of an accretion measure. Accretion measures are susceptible to biases resulting from the possibility that materials have selectively survived or been selectively deposited. Selective survival occurs when only a non-representative sampling of the population exists. Selective deposit occurs when physical traces are created on a non-random basis.

III. METHODOLOGY

A. SELECTING STUDIES FOR REVIEW

1. Choosing Sources from which to Obtain Studies

Journals in information systems and related fields, published in English between 1970 and 1990, were the source from which studies of information systems effectiveness were selected for review. These journals are accepted as appropriate professional reading material and publishing outlets for information systems academics (Davis, 1980; Hamilton and Ives, 1983; Vogel and Wetherbe, 1984; Alavi et al., 1989). The journals surveyed were:

1. *Academy of Management Journal*
2. *Accounting Review*
3. *ACM Computing Surveys*
4. *Administrative Science Quarterly*
5. *Communications of the ACM*
6. *Data Base*
7. *Datamation*
8. *Decision Sciences*
9. *EDP Analyzer*
10. *Harvard Business Review*
11. *IEEE Computer*
12. *Information and Management*
13. *Interfaces*

14. *Journal of Management Information Systems*
15. *Journal of Systems Management*
16. *Management Information Systems Quarterly*
17. *Management Science*
18. *Omega*
19. *Sloan Management Review*

2. Identifying Specific Studies for Review

a. On-Line Bibliographic Search

An on-line search in January, 1989 reported 128 items using the string of key words: (Productivity or Effectiveness) and (Measures or Measurement or Assess or Assessment) and Information Systems. Out of these, 18 articles appeared, on the face of it, to report empirical assessments of information systems effectiveness as determined by a reading of their titles. None of them, despite having been published in information systems journals (e.g. *MIS Quarterly*, *Journal of MIS*, *Information and Management*, *Data Base*), are among the 37 empirical studies of information systems effectiveness discussed here. Some focused on the development of survey measurement instruments, a category that was, as it is explained below, excluded from this analysis. Other articles were from trade and industry publications aimed at MIS practitioners and dealt with advice on effectiveness measurement. They did not report empirical studies of system effectiveness.

b. Manual Bibliographic Search

It was suspected that the empirical literature on information systems effectiveness was more extensive than the handful of references revealed by the on-line search. A manual search of the same journals was conducted. Every issue of all the journals, dating back to 1970, were searched. The manual searching brought forth the difficulty with the on-line search; deficient key words. Authors, for example, used key words such as "manufacturing and engineering systems, return on investment, utilization process, human information processing, information system design, system evaluation, information system investment, cost/benefit calculations, management reporting, management issues, accuracy, content, information characteristics and users evaluation." Such key words were, in retrospect, quite appropriate for describing various aspects evaluating information systems effectiveness. They simply were not the ones that had been imagined to be relevant to the on-line search. No single search could have accommodated so many key words. While a sequence of searches could have employed a large number of key words, the limited on-line searching resources available for this study did not make that alternative feasible.

The manual effort produced 118 articles that were identified (by title, key words and abstracts) as dealing with the evaluation of information systems

effectiveness. The reference lists in these articles, in turn, identified another 31 articles that had been overlooked because of title, bringing the total number of items in the literature base to 149. Most of these articles did not report empirical studies.

c. Selection of Specific Studies

Excluded immediately were non-empirical analyses of the assessment of information systems (Chervany and Dickson, 1970; Coleman and Riley, 1972; Mason and Mitroff, 1973; Carlson, 1974; Soergel, 1976; Strassmann, 1976; Tharp and Taggart, 1976; Radecki, 1976; Dickson et al., 1977; Arnovick and Gee, 1978; King and Schrems, 1978; Ginzberg, 1978; Mason, 1978; Kleijnen, 1979; Worthley, 1980; Ginzberg, 1980; Hamilton and Ives, 1982; Borko, 1983; Keim and Janaro, 1982; Markus and Robey, 1983; Mason, 1984; Calista, 1985; Bearman et al., 1985; Gremillion and Pyburn, 1985; Lay, 1985; Maggiolini, 1986; Martin and Trumbley, 1986; Rouse, 1987; Marsden and Pingry, 1988; Trice and Treacy, 1988).

Also excluded from this review were empirically-based articles that do not deal directly with a study of information systems effectiveness but rather were concerned with the validation of attitudinal questionnaires and other instruments (Larcker and Lessig, 1980; Mick et al., 1980; Chandler, 1982; Bailey and Pearson, 1983; Srinivasan, 1985; Dominick, 1987; Hill et al., 1987; Miller and Doyle, 1987; Baroudi and Orlikowski, 1988; Money et al., 1988; Montezema,

1988). While these works involve the development of research techniques that contribute to how we know what we know about information systems effectiveness, they were left out because they were not primarily engaged in studies that had a potential for developing theory about behavior related to information systems effectiveness.

A miscellany of pieces that seemed to have the titles sought but actually dealt with other issues were also removed from the original 149 articles. Those addressing evaluations of the technical performance of hardware (e.g. computer processor performance in millions of instructions per second) were not included. Similarly, articles dealing with efficiency in software development activities (e.g. programmer productivity in terms of lines of code written per day) were excluded.

Finally, my search efforts boiled down to the 37 reports of empirical studies of the effectiveness of information systems in its various formulations. A listing of these reports is provided at Appendix A. Surely, for all of this, some studies may have been missed, possibly some important studies. For that I apologize in advance to those researchers who might have been overlooked. It is my contention that even though every last empirical study of information systems effectiveness may not have been included in this research, I do believe that those included are representative of the field.

B. REVIEWING THE STUDIES

The 37 empirical studies (listed in Appendix A) were individually reviewed to identify data collection instruments and discussions of validity issues. Researchers often used multiple data collection instruments in the conduct of their studies, with each instrument contributing only a portion of the measurements upon which the researchers' findings were based. This use of multiple data collection instruments necessitated the development of a methodology to identify and separately analyze each instrument used in the 37 studies.

Each study was carefully read to identify all data collection instruments contributing to the findings of the study. Each instrument was further analyzed to record information concerning its design, purported focus of measurement, administration, and validity. The analysis process for each study essentially consisted of the following:

1. Identification and categorization of all data collection instruments used by the information systems researchers for the given study.
2. Categorization of each identified data collection instrument according to what the information systems researchers purported it to measure.
3. Examination of the way in which each identified data collection instrument were administered.
4. Identification of how the information systems researchers dealt with the validity of each identified data collection instrument.

The primary manner in which data were collected during the analysis of each data collection instrument was through the careful reading of the 37 studies. Pertinent information was identified and extracted from the studies, clearly requiring the exercise of personal judgment. Consequently, all findings resulting from this research are ultimately based upon face validity. The remainder of this section provides details on how the analysis was conducted and recorded.

1. Identification and Categorization of Instruments

The initial goal of the review was to identify data collection instruments used by the information systems researchers to measure aspects of information systems. Instruments that were used solely in the design of other measuring instruments, for example preliminary interviews conducted to design questions appearing later in a questionnaire, were not considered of interest to this research.

Each data collection instrument was classified by the data collection technique it primarily employed. Instruments were classified as questionnaires, interviews, archival records, and observations.

Each data collection instrument was further analyzed to determine specific design characteristics of the technique. Data were gathered on the specific design of each questionnaire, interview, collection of archival

records, or set of observations used by the researchers. The type of scaling and original source of each questionnaire was recorded. The amount of schedule and structure existing in each interview was recorded. The source and types of records used for each collection of archival data was recorded. The manner in which observations were conducted was recorded.

2. Categorization of Instruments by Measures

It is of interest to determine what information systems researchers purported to measure with data collection instruments. Each instrument is purported by its designer to provide one or more general types of measurements relating to information systems. This study categorizes instruments according to the type or types of measurements it purportedly records. The instruments used by researchers were categorized as purportedly measures of the following:

1. Attitude or perception
2. Behavior
3. System characteristics
4. Situational characteristics.

Each instrument used in the 37 studies was analyzed to determine the category or categories of measures that its designers claimed it provided.

Measures of attitude or perception are provided by respondents when solicited by researchers. This usually

involves respondents providing opinions or testimony on some aspect of an information system. Consequently, the researchers are indirectly measuring the information system through the observations provided by others. Measures of attitude or perception typically involve aspects of information systems such as user involvement, effectiveness of systems, and satisfaction with systems.

Measures of behavior record the occurrence of behavior related to information systems. The behavior usually takes the form of interactions between users and information systems or actions taken as a result of outputs provided by information systems. Measures of behavior usually involve the researchers directly observing or deducing specific behavior relative to information systems or their users. Observation and archival records are often used to collect measures of behavior. Data recorded through the review of computer inquiry logs or account records regarding system usage is an example of measures of behavior.

Measures of system characteristics are data which purport to directly represent some aspects of information systems. Examples are cost of systems, the effectiveness of systems, the impact of systems, the success of systems, or the satisfaction of users. Measures of system characteristics differ from measure of attitude or behavior

in that they are purported to directly measure aspects of information systems.

Measures of situational characteristics provide data concerning the environment within which the system operates. Measures of situational characteristics are concerned with describing components of the environment that essentially impact upon information systems. Measures of situational characteristics differ from the previously discussed types of measures in that they do not record data on the impact of the studied information systems; however they do provide insight into the conditions surrounding information systems. Examples of components of the environment that are measured by researchers are organizational structure, historical performance of business, personnel profiles, and industry trends.

3. Examination of the Way Instruments are Administered

The way in which data collection instruments are administered is an essential part of the design of an experiment. It involves the selection of potential respondents, distribution of the data collection instruments, and follow-up actions taken to encourage response and account for non-response. The manner in which researchers administer instruments can fundamentally affect the validity of data.

The goal of this examination is to provide information on how researchers are administering data

collection instruments. Analysis of the sampling process used by researchers may provide information regarding the validity of the data they collect. Each identified instrument was examined to determine the following:

1. Who responded to each instrument.
2. The size of the sample taken with each instrument.
3. The response rate achieved for each instrument, with the exception of archival records.
4. How each instrument was distributed.
5. Whether follow-up actions were taken to improve the participant response rate for each instrument.
6. Whether differences between respondents and non-respondents to each instrument were identified by the information systems researchers.

4. Identification of how Researchers dealt with Validity Issues

The primary focus of this study is to explore validity issues stemming from measurements of information systems. Identifying how information systems researchers discussed, claimed, and substantiated the validity of data collected during their studies provides a basis for assessing the role validity issues play in information systems research. The following information was recorded for each data collection instrument in order to establish how researchers dealt with validity issues:

1. How internal validity was addressed.
2. How external validity was addressed.

3. The types of validity claimed or implied.
4. The source of the validity claimed or implied.

All discussion regarding the validity of measurements derived from a given instruments were recorded. Secondary sources were examined and noted when cited in a discussions. All recorded discussions were then determined to address internal and or external validity issues, and classified as such. The classified discussions were then further summarized for ease of understanding. When no discussions of internal and or external validity were presented, it was so noted as not discussed. Further analysis was not required for instruments without discussions of internal and external validity.

Data collection instruments having discussions of internal and or external validity were further analyzed. The discussions were determined to claim, imply, or deny the validity of measurements. The types of validity claimed or implied were noted, as well as denials of validity. Whether validity was claimed or implied was also noted.

When the validity of measurements was claimed or implied for a given data collection instrument, the source of the validity was noted. It was also noted when information systems researchers claimed or implied validity but failed to cite a source.

Discussions that collectively address the validity of measurements derived using multiple data collection

instruments in a given study were recorded. These discussions were further analyzed as if they represented a single data collection instrument. The results of such analyses are identified as "collectively", when such discussion were present in a study.

C. RECORDING THE DATA

Data were extracted from the 37 studies using a separate summary sheet for each study. (Appendix B) In order to consolidate the summary sheets into a more understandable format, a matrix was created to present the data as detailed in the previous section. (Appendix C) Both the summary sheets and the matrix are used as sources for the findings of this study.

IV. FINDINGS

Appendix B contains a detailed analysis of the 37 analyzed studies. Appendix C is a consolidation of data presented in Appendix B. Both of these appendices were used as sources for the findings that follow.

A. INSTRUMENTS USED BY RESEARCHERS

1. Summary of Instruments

The number and types of data collection instruments used by information systems researchers during the 37 studies are shown in Table 1.

TABLE 1
DATA COLLECTION INSTRUMENTS USED

INSTRUMENT	# STUDIES USING	# TIMES USED
Questionnaire	29	36
Archival	14	15
Interview	8	9
Observation	4	4
Unidentified	1	1

The column labeled # *STUDIES USING* contains data regarding the number of studies that used specified types of instruments. The column labeled # *TIMES USED* contains data regarding the number of times each type of instrument was used during the 37 studies. The number of instruments used

exceeded the number of studies because some researchers used multiple data collection instruments during the conduct of a single study.

Table 1 reveals that questionnaires were used in over three-quarters of the studies. Twenty-nine of 37 studies included questionnaires. Data collection which involved archival records, interviews, or observations was less frequent. When these latter data collection techniques were used, they were often used in conjunction with questionnaires.

The 37 studies used 65 individual data collection techniques. Over half of the data collection techniques used were questionnaires, with 36 of the 65 techniques having been classified as questionnaires.

2. Use of Multiple Data Collection Instruments

Table 2 illustrates the use of multiple data collection instruments by information systems researchers. *Use of multiple data collection instruments* denotes the incorporation of more than one data collection instrument in a given study. For example, Lucas (1974) used two questionnaires and Colton (1972) used a questionnaire and an interview, thus each used multiple data collection instruments. Table 2 shows the number of studies that used one, two, three, or four data collection techniques.

TABLE 2**USE OF MULTIPLE DATA COLLECTION INSTRUMENTS**

	NUMBER OF INSTRUMENTS USED			
	One	Two	Three	Four
NUMBER OF STUDIES	19	9	8	1

Table 2 shows that over half of the researchers used only one instrument in their research designs. A further analysis of the 19 one-technique studies revealed that they used ten questionnaires, six sets of archival records, two collections of observations, and one interview.

3. Characteristics of Questionnaires

Details concerning design characteristics were provided for 31 of the 36 questionnaires used in the 37 studies. Even when discussions were presented, they rarely extended beyond the identification of the types of scales used to score instruments. Few studies clearly identified the origin or source of questionnaires used. Discussions were insufficient to develop findings about the structure of questionnaires.

Questionnaires used by researchers were largely based upon ordinal scales. Of the 31 questionnaires that discussed their characteristics, 30 were based upon ordinal scales. Five, seven, and ten point ordinal scales were typically used in the design of the questionnaires. Five studies contained discussions specifically stating that their corresponding questionnaires were Likert-type; Franz

and Robey (1986), Aldag and Power (1986), Franz et al. (1986), Gallupe and DeSanctis (1988), Tait and Vessey (1988).

The origin of the questionnaires were discussed for a third of the questionnaires used. The absence of discussions left uncertain whether the questionnaires were of original design or were developed during previous studies. While none of the questionnaires were explicitly identified as having been of original design, however, it is possible that some were. Eleven of the 36 questionnaires were identified as developed during previous studies. These questionnaires were attributed to one or more of the following: Smith et al. (1969), Lucas (1973), Schultz and Slevin (1975), Wolek (1975), Elizur and Guttman (1976), Sims et al. (1976), Ein-Dor and Segev (1978), Keen (1981), McFarlan (1981), Bailey and Pearson (1983), Ives et al. (1983), Baroudi and Orlikowski (1988), and Doll and Torkzadeh (1988).

4. Sources of Archival Records

Researchers used archival records 15 times in the 37 studies. They provided discussions identifying the sources of the archival records for 13 of the 15 instances in which they were used. Over two-thirds, 9 of the 13 discussions, identified the archival records as computer files or computer generated reports. Insufficient information was

provided in the discussions to clearly establish the sources of the remaining archival records.

5. Characteristics of Interviews

Nine interviews were identified in the 37 studies. Little discussion was presented regarding these interviews. No determination of structure or schedule could be made for six of the nine interviews. Three interviews cited combinations of structured, unstructured, scheduled, and unscheduled designs.

6. Characteristics of Observations

Observations were identified four times as the data collection technique in the 37 studies. The researchers discussed the manner in which the observations were made each time they were identified as used. These discussions were used to determine observer roles, as defined by Denzin (1970). Three of the observations were collected by participant observers. The fourth set was collected by a complete observer.

B. WHAT RESEARCHERS PURPORTED TO MEASURE

Instruments used in the 37 studies were categorized as purported to measure of attitude, behavior, system characteristics, or situational characteristics. Measures of attitude typically consisted of stated opinions or testimony as provided by respondents. Measures of behavior recorded the occurrence of behavior related to information systems. Measures of system characteristics are data which

are purported to directly represent aspects of information systems. Measures of situational characteristics provide data concerning the environment within which systems operate. Further explanations of these categories of measures are provided in Chapter III.

Table 3 shows what the researchers purported to measure in the 37 studies. Some instruments purportedly collected more than one category of measures. For example, Swanson (1974) used a single questionnaire to purportedly measure both attitude and behavior. Consequently, the total number of purported measures is greater than the total number of instruments used.

TABLE 3
PURPORTED MEASURES OF INSTRUMENTS

TYPE of DATA COLLECTION INSTRUMENT	# of TIMES USED	NUMBER of PURPORTED MEASURES by INSTRUMENT TYPE and CATEGORY of MEASURE				
		System	Attitude	Behavior	Situation	Unknown
Questionnaire	36	13	25	11	6	1
Archival	15	5		4	6	
Interview	4	5	2		2	
Observation	4	4				
Unknown	1			1		
TOTAL	65	27	27	16	14	1

Table 3 shows that the 65 instruments made a combined total of 85 purported measures, distributed between four categories. Questionnaires were the only instrument identified to purportedly measure multiple categories of

measures with a single data collection instrument. Questionnaires were also the only instrument identified to purportedly measure all categories of measures. Questionnaires and interviews, when considered together, were identified 27 times as purported measures of attitudes and 38 times as purported measures of the remaining categories. Analysis of archival records were identified to purportedly measure all categories except attitudes. Observations were identified solely as purported measures of systems characteristics.

C. THE WAY IN WHICH INSTRUMENTS WERE ADMINISTERED

1. Selection of Sample Populations

The information systems researchers sampled populations from a variety of professions and functional specialties. All 37 studies appear to have used samples selected for convenience or availability. Randomness was introduced into the sampling process only after the sample populations were identified.

2. Identity of Respondents

A total of 49 questionnaires, interviews, and observations were used in the 37 studies. Managers, computer personnel, and computer users were identified as respondents or observed subjects for 43 of the 49 instruments. The remaining six instruments used students as respondents or observed subjects. King and Rodriguez (1978), Aldag and Power (1986), Durand et al. (1987), and

Gallupe and DeSanctis (1988) were the studies that used students. All other studies relied on respondents or observed subjects that used information systems in operational environments.

3. Size of Samples

Information identifying the size, duration, or frequency of sampling was provided for only 38 of the 65 data collection instruments. When such information was provided, it typically consisted of identifying only the total number of respondents to given instruments. The total number of respondents was provided for 34 instruments, as shown in Table 4. The duration of sampling was provided in three studies; Swanson (1974), Ball (1980), and Ginzberg (1981). The frequency of sampling was provided in one study, Englander and Englander (1985).

TABLE 4
SAMPLE SIZE

	SAMPLE SIZE		
	1 to 50	51 to 100	101 to 500
# of INSTRUMENTS	8	12	14

4. Response Rates

A total of 40 questionnaires and interviews were used in the 37 studies. Researchers identified the response rates for only 20 of these instruments. Table 5 shows the response rates that were identified for each type of instrument.

TABLE 5

DISTRIBUTION OF IDENTIFIED RESPONSE RATES

TYPE OF INSTRUMENT	RESPONSE RATE ACHIEVED				
	0-20%	21-40%	41-60%	61-80%	81-100%
Questionnaire	1	1		8	8
Interview				1	1
TOTALS	1	1		9	9

Further analysis of the response rates reveals that the researchers rarely reported rates higher than 95 percent. Only three of the 21 instruments exceeded a 95 percent response rate; questionnaires used by Lucas (1975b), Robey (1979), and Bruwer (1984). A 100 percent response rate was achieved for only the questionnaires used by Robey (1979) and Bruwer (1984). Unfortunately, neither study discussed how the 100 percent response rate was achieved. At the opposite extreme, the findings of two studies were based on instruments achieving a response rate of less than 40 percent: questionnaires used by Snitkin and King (1986) and Baroudi et al. (1986). Snitkin and King (1986) achieved a response rate of 18 percent and Baroudi et al. (1986) of 25 percent.

5. Distribution Methods

Data were gathered regarding the manner in which questionnaires were distributed and interviews conducted. A total of 36 questionnaires were used in the 37 studies. The means of distribution was clearly identified for 18 of the

36 questionnaires. Mail was identified as the means of distribution for 15 of the questionnaires. Three of the questionnaires were identified as administered in person.

A total of nine interviews were used in the 37 studies. The manner in which the interviews were administered was identified for six of the nine interviews conducted. These six interviews were identified as administered in person. No interviews appear to have been administered by telephone.

The information systems researchers provided little discussion regarding actions taken to improve response rates. A total of 40 instruments used questionnaires and interviews, yet only six instances of follow-up actions were clearly identified. All six instances involved questionnaires. Colton (1972) used a second mailing. Lucas (1975a) and (1975b) stated that unspecified follow-up actions were taken for each questionnaire. Ginzberg (1981) used a follow-up message for his two questionnaires. Tait and Vessey (1988) used a telephone call.

6. Differences between Respondents and Non-Respondents

The 40 data collection instruments that used questionnaires or interviews were examined to determine whether researchers discussed any differences between respondents and non-respondents. Discussion of differences were presented for ten of these instruments, all of which

were questionnaires. When a discussion of differences was presented, it typically provided sparse information.

Ginzberg (1981) presented data, based on an analysis of both groups, suggesting that no significant, nor sizeable, difference existed between respondents and non-respondents to his three questionnaires. Cron and Sobol (1983) specifically identified major non-respondents and discussed differences. Robey (1979) and Bruwer (1984) claimed response rates of 100 percent, thus no discussion of non-respondents was necessary. Snitkin and King (1986) stated they were prevented from performing an analysis of differences. Baroudi et al. (1986) linked non-respondents to the use of old mailing lists. Franz et al. (1986) performed an analysis of the attitudes of dropouts from his experiment, which was used to suggest differences between respondents and non-respondents to his two questionnaires.

D. HANDLING OF VALIDITY ISSUES

1. Discussions of Internal Validity

Discussions regarding the internal validity of individual instruments were presented for only 19 of the 65 instruments. Table 6 identifies, by type of instruments used, the presentation of such discussions.

TABLE 6

DISCUSSIONS REGARDING INTERNAL VALIDITY

TYPE of INSTRUMENT	TIMES USED	TIMES DISCUSSED	TIMES NOT DISCUSSED
Questionnaire	36	16	20
Archival	15	1	14
Interview	9	2	7
Observation	4	2	4
Unidentified	1	0	1
TOTALS	65	19	46

Analysis of the 19 discussions reveals that the researchers addressed internal validity issues in a variety of ways. References detailing ways in which specific studies addressed internal validity are provided in subsequent paragraphs. Most frequently the discussions identified secondary sources as the original developers of their instruments. Some discussions clearly cautioned readers that the internal validity of data collection instruments had not been demonstrated. Least common were discussions that asserted that internal validity had been demonstrated.

Eleven of the discussions cited secondary sources as a means of possibly substantiating the internal validity of individual data collection instruments; Lucas (1974), Lucas (1975b), King and Rodriguez (1978), Robey and Zeller (1978), Lucas (1978), Robey (1979), Baroudi et al. (1986), Franz et

al. (1986), Tait and Vessey (1988), and Cronan and Douglas (1990). Appendix B identifies the specific source(s) cited by each of these studies. The citation of secondary sources implies that the individual instruments were validated in previous studies. One can expect cited secondary sources to provide information about the internal validity of individual instruments.

When the secondary sources cited by Lucas (1974), Lucas (1975b), King and Rodriguez (1978), Robey and Zeller (1978), Robey (1979), and Franz et al. (1986)¹ were examined, little discussion of internal validity was found. The cited secondary sources that provided insufficient discussion of internal validity were Lucas (1973), Schultz and Slevin (1975), Wolek (1975), Ein-Dor and Segev (1978), Keen (1981), and McFarlan (1981).

Secondary sources cited by Lucas (1978), Baroudi et al. (1986), Franz et al. (1986)², Tait and Vessey (1988), and Cronan and Douglas (1990) directly discussed the internal validity of individual instruments. The cited secondary sources that provided adequate discussion of internal validity were Smith et al. (1969), Elizur and Guttman (1976), Sims et al. (1976), Bailey and Pearson

¹Reference to secondary source of Sims, Szilagyi, Keller (1976) provided discussion of validity issues.

²Reference to secondary source of Schultz and Slevin (1975) provided little discussion of validity issues.

(1983), Ives et al. (1983), Baroudi and Orlikowski (1988), and Doll and Torkzaheh (1988).

Six discussions acknowledged deficiencies regarding the internal validity of individual instruments. Gallagher (1974) informed readers that the validity of his questionnaire had not been established. Edström (1977) identified weaknesses in his interview stemming from problems associated with human memory, perceptions, and selection of respondents. Englander and Englander (1985) suggested that variables not measured by their archival records may have adversely impacted the results of their experiment. Lincoln (1986) addressed the unreliability of user interviews. Baroudi et al. (1986) expressed concerns over the ordering of experimental variables and the use of subjective rather than objective measures. Tait and Vessey (1988) acknowledged problems resulting from when measures were collected, influences on respondent's attitudes, the use of Likert-type scales, and insufficient validation of instruments.

In four cases, researchers implied or asserted that instruments had demonstrated internal validity. Lucas (1978) asserted that the quasi-experimental research design and statistical techniques used provided increased confidence. Mansour and Watson (1980) implied that their questionnaire possessed internal validity on the basis of its reliability as a predictor. Franz and Robey (1986)

stated that they developed and validated their questionnaire. They provided details of how this was accomplished. Aldag and Power (1986) implied, through persuasive discussion, that their questionnaire had demonstrated internal validity.

2. Discussions of External Validity

Information systems researchers presented discussions regarding the external validity of individual instruments for only 22 of the 65 instruments. Table 7 identifies, by type of instrument, the presentation of such discussions.

TABLE 7

DISCUSSIONS REGARDING EXTERNAL VALIDITY

TYPE of INSTRUMENT	TIMES USED	TIMES DISCUSSED	TIMES NOT DISCUSSED
Questionnaire	36	18	18
Archival	15	2	13
Interview	9	1	8
Observation	4	1	3
Unidentified	1	0	1
TOTALS	65	22	43

Analysis of the 22 discussions reveals that the researchers also addressed external validity issues in a variety of different ways. References detailing ways in which specific studies addressed internal validity are provided in subsequent paragraphs. Secondary sources were

referenced as the original designers of individual data collection instruments. In other discussions, researchers generalized their results without providing a justification. Some discussions clearly cautioned readers that the external validity of instruments had not been demonstrated.

References to secondary sources were considered an attempt to substantiate the external validity of individual data collection instruments. Eleven studies cited secondary sources; Lucas (1974), Lucas (1975b), King and Rodriguez (1978), Robey and Zeller (1978), Lucas (1978), Robey (1979), Baroudi et al. (1986), Franz et al. (1986), Tait and Vessey (1988), and Cronan and Douglas (1990). Appendix B identifies the specific source(s) cited by each of these studies. As noted earlier, the citation of secondary sources implies that the individual instruments were validated in previous studies. Cited secondary sources are expected to provide readers with information regarding the external validity of individual instruments.

When the secondary sources cited by Lucas (1974), Lucas (1975b), King and Rodriguez (1978), Robey and Zeller (1978), Robey (1979), and Franz et al. (1986)³ were examined, little discussion of external validity was found. The cited secondary sources that provided insufficient

³Reference to secondary source of Sims, Szilagyi, Keller (1976) provided discussion of validity issues.

discussion of external validity were Lucas (1973), Schultz and Slevin (1975), Wolek (1975), Ein-Dor and Segev (1978), Keen (1981), and McFarlan (1981).

Secondary sources cited by Lucas (1978), Baroudi et al. (1986), Franz et al. (1986)⁴, Tait and Vessey (1988), and Cronan and Douglas (1990) directly discussed the external validity of individual instruments. The cited secondary sources that provided adequate discussion of external validity were Smith et al. (1969), Elizur and Guttman (1976), Sims et al. (1976), Bailey and Pearson (1983), Ives et al. (1983), Baroudi and Orlikowski (1988), and Doll and Torkzaheh (1988).

Seven of the discussions about external validity involved researchers generalizing the findings of their studies. By having generalized findings, these researchers were considered to have at least implied that the external validity of their individual instruments had been demonstrated. Elchesen (1978), Mansour and Watson (1980), Altmeyer and Bozeman (1981), Cron and Sobol (1983), Bruwer (1984), Decker and Plumlee (1985), and Kapsales (1986) all generalized findings resulting from their individual instruments. Cron and Sobol (1983) were the only researchers that explicitly discussed the external validity of their individual instruments.

⁴Reference to secondary source of Schultz and Slevin (1975) provided little discussion of validity issues.

Six of the discussions of external validity acknowledged deficiencies. Gallagher (1974) and Franz and Robey (1986) stated that the validity of their questionnaires had not been established. Tait and Vessey (1988) implied that the validity of their questionnaire had not been established. Edström (1977) cautioned against generalizing the findings from his interviews. Cron and Sobol (1983) and Aldag and Power (1986) cautioned that further studies involving their questionnaires were required.

Baroudi et al. (1986) provided the only discussion of actions taken which allegedly enhanced the abilities to generalize their results. Researchers typically either ignored external validity issues or generalized findings without supporting discussions.

3. Types of Validity Claimed or Implied

Researchers provided discussions about either the internal or external validity of 25 of the 65 individual data collection instruments. Specific types of validity were claimed or implied for only 15 of the 25 instruments. The remaining ten instruments could not be linked to a specific type of validity.

As previously elaborated, discussions regarding six instruments involved only references to secondary sources that were found to provide little or no discussions of validity issues. Consequently, such discussions were not

considered as having claimed or implied a specific type of validity for the involved instruments. Other discussions were presented asserting that four instruments had not been validated, again not identifying a specific type of validity.

An analysis of the discussions which claimed or implied a specific type of validity for the remaining 15 instruments reveals that the researchers rarely explicitly claimed validity. Explicit claims of validity were made for four instruments. In contrast, they implied specific types of validity for ten instruments.

The discussions that explicitly claimed validity involved four of the 37 studies. Discussions identifying a specific type of validity were presented for five of the 65 instruments used. All instruments with such discussions were questionnaires.

Aldag and Power (1986) made claims of internal validity for their questionnaire. Baroudi et al. (1986) made claims of internal and external validity, specifically citing content and construct validity for one of their questionnaires. Franz et al. (1986) made claims of internal and external validity, specifically citing construct and discriminant-convergent validity for one of their questionnaires. Cronan and Douglas (1990) also made claims of internal and external validity, specifically citing

construct, convergent-discriminant, and criterion validity for their two questionnaires.

An analysis of the discussions which addressed validity, having excluded references to secondary sources that provided little or no information regarding validity issues, revealed that researchers implied specific types of validity for ten instruments. The internal validity of two instruments were implied; individual questionnaires used by Lucas (1978) and Franz and Robey (1986). The external validity of six instruments were implied; observations collected by Elchesen (1978), questionnaires administered by Altmeyer and Bozeman (1981), Cron and Sobol (1983), Bruwer (1984), and archival records analyzed by Decker and Plumlee (1985), and Kapsales (1986). Both the internal and external validity of two instruments were implied; a questionnaire administered by Mansour and Watson (1980) and observations collected by Durand et al. (1987).

4. Sources of Claimed or Implied Validity

Five questionnaires claimed a specific type of validity; Aldag and Power (1986), Baroudi et al. (1986), Franz et al. (1986), and Cronan and Douglas (1990). They discussed the analyses of instrument measures as justification for claiming specific types of validity.

Ten data collection instruments were implied to possess a specific type of validity; Elchesen (1978), Lucas (1978), Mansour and Watson (1980), Altmeyer and Bozeman

(1981), Cron and Sobol (1983), Bruwer (1984), Decker and Plumlee (1985), Franz and Robey (1986), Kapsales (1986), and Durand et al. (1987). None of the discussions which involved these instruments identified the source of the validity.

5. Collectively Addressing Validity Issues

Information systems researchers used multiple data collection instruments in 18 of the 37 studies. Fourteen of the studies that involved multiple instruments included discussions that addressed validity issues in a collective manner. Essentially, the researchers addressed the collective validity of the study, rather than the validity of individual instruments.

Data were collected regarding discussions that collectively addressed either internal or external validity issues. These discussions were used to determine the specific types of validity that researchers implied or claimed their studies demonstrated. None of the discussions identified the sources of implied or claimed validity.

Analysis of the 14 discussions which collectively addressed validity issues reveals researchers asserted the validity of six studies had not been established; Swanson (1974), Lucas (1975a), Lucas (1975b), Schewe (1976), Neumann and Segev (1979), and Robey (1979). A single study, Gallupe and DeSanctis (1988), included discussion that implied only internal validity had been collectively demonstrated. Three

studies included discussions that implied only external validity had been collectively demonstrated; Hall and Lincoln (1976), Robey and Zeller (1978), and Ginzberg (1981). Another two studies, Powers and Dickson (1973) and Lucas (1974), claimed that only external validity had been collectively demonstrated. Two studies implied that both internal and external validity had been collectively demonstrated; Franz et al. (1986) and Cronan and Douglas (1990). Additionally, Cronan and Douglas (1990) was the only study to collectively cite specific types of internal validity; construct and convergent validity.

Only two of the 37 studies included discussions that individually and collectively addressed validity issues. Franz et al. (1986) and Cronan and Douglas (1990) included discussions regarding the validity of individual instruments. They also provided discussions regarding the collective validity of their studies.

V. CONCLUSIONS

The conclusions that follow are based upon key findings presented in the previous chapter. The conclusions are ordered in same sequence as the findings. Only summary totals are provided in this chapter. References to specific instruments and studies which comprise the summary totals are located with the corresponding findings, in the previous chapter.

A. DATA COLLECTION INSTRUMENTS

1. Selection of Instruments

Questionnaires were the primary data collection instrument used by researchers. Questionnaires were used in 29 of the 37 studies, accounting for 36 of the 65 instruments. This suggests that the majority of the data from which researchers generate findings are collected with questionnaires. Their reliance on questionnaires leaves researchers dependent upon respondents to report on effectiveness of information systems. Denzin (1970) discussed threats to validity associated with the use questionnaires. The obtrusive nature of questionnaires, respondent biases, and human memory errors are likely to result in many respondents providing inaccurate reports of information systems effectiveness.

Researchers relied on analysis of archival records in a minority of their studies, representing only 15 of the 65 instruments. Information systems are, by their very nature, generators and repositories of archival records. The archival records stored in computer files provide an unobtrusive manner in which to collect generally accurate data regarding information systems. Surprisingly few researchers took advantage of archival records as a means of studying information systems.

Few researchers used alternative data collection techniques, such as interviews or observations. These techniques accounted for only 13 of the 65 instruments. Difficulties associated with administering interviews and collecting observations may account for their less frequent use in the 37 studies.

Interviews require direct person-to-person exchanges, which are usually time consuming and costly to conduct. Researchers may have opted to use questionnaires rather than interviews, since questionnaire are generally easier and cheaper to administer. Interviews were identified as only 9 of the 65 instruments. Interviews are subject to many of the data accuracy problems associated with questionnaires. They are obtrusive, susceptible to personal biases, and prone to human memory errors.

Observations are difficult to collect outside the laboratory; consequently they are seldom used to measure

operational information systems. Observations were the bases for only four of the 65 instruments. Observations provide accurate data, yet researchers appear reluctant to develop experimental designs that use this data collection technique.

2. Impact upon Triangulation

Multiple data collection instruments were used in fewer than one-half of the studies' research designs. Most researchers were precluded from triangulating measures because 19 of the 37 studies involved research designs that used only one instrument. A greater use of multiple instruments would have provided more opportunities for triangulation, enhancing the validity of data collected in the studies.

3. Problems with Designs of Questionnaires

The researchers demonstrated a reliance on ordinal scales, using them in 30 of the 31 questionnaires. Only five studies explicitly identified the questionnaires as Likert-type. Because the researchers consistently discussed the use of five, seven, and ten point scales, most of the questionnaires were presumedly Likert-type. Galletta and Lederer (1987) cautioned that numerous problems are associated with Likert-type scales. These problems include scale units and origins (anchoring), derivation of a score by adding heterogeneous item scores, and a problem similar to that with the user involvement measure, and the use of

parametric statistics. Since the majority of the discipline's studies appear to use questionnaires involving Likert-type designs, information systems research is vulnerable to these problems.

Researchers failed to state, in 25 of 36 questionnaires, whether they were of original design or adapted from previous studies. Not knowing the source of an instrument's design, impedes evaluation of its validity. The failure to cite original design sources wrongly precluded readers from referencing discussions of validity issues which may have appeared in previous studies.

4. Use of Computer Records

Analyses of existing computer records accounted for 13 of the 65 instruments. Few researchers are exploiting computer records, which might already reside on the investigated information systems, as the bases of their data. Rather than using objective measures provided by archival records, they are primarily turning to a secondary subjective measures, as provided by human respondents.

5. Ambiguous Designs of Interviews

Sufficient details were provided to make determinations regarding schedule and structure for only three of the nine interviews conducted. None of the information systems researchers provided sufficient discussion to develop an understanding of the manner in which the interviews were conducted and the questions

presented. Researchers did little more than identify that interviews were conducted, thus making interpretations of conduct and content virtually impossible.

6. Obtrusive Role of Observers

Only four of the 37 studies involved collection of data by observers. The researchers used participant observers in three studies and complete observers in one study. Participant observation is an obtrusive form of data collection and complete observation is an unobtrusive form of data collection. The more frequent reliance upon participant observation demonstrates a possible tendency for researcher to rely more on obtrusive rather than unobtrusive forms of observation.

Despite having used obtrusive forms of observation, none of the researchers assessed impacts of observers on studied information systems. Researchers failed to recognize that the introduction of observers impacted recorded measures. Although unobtrusive observation of information systems is clearly desirable over obtrusive observation, it is difficult for the observer to remain concealed and can be very time consuming when conducted outside the laboratory. This may explain why the majority of researchers who used observations selected the obtrusive form of participant observation.

B. FAILURE TO RECOGNIZE MEASURES OF ATTITUDE OR BELIEF

Marshall and Rossman (1989) describes questionnaires as instruments that measure sets of attitudes or beliefs. Interviews also solicit the respondent to express attitudes or beliefs regarding phenomena of interest. Researchers who use questionnaires or interviews are, by the very nature of these instruments, measuring the attitudes or beliefs of respondents.

The researchers used a total of 45 questionnaires and interviews. Only 27 of the 45 questionnaires and interviews were acknowledged to have measured attitudes or beliefs. Many researchers did not acknowledge or were unaware that they measured attitudes or beliefs with questionnaires and interviews.

Many researchers purported that they collected other types of measures with questionnaires and interviews. The 45 questionnaires and interviews used by the researchers were purported to provide 37 measures of system characteristics, behavior, and situational characteristics. Many researchers erroneously believed questionnaires and interviews measure system characteristic, behavior, and situational characteristics; when in fact, these instruments exclusively measure attitudes or beliefs.

C. ADMINISTRATION OF DATA COLLECTION INSTRUMENTS

1. Samples of Convenience

All 37 studies appear to involve samples selected on bases of convenience. The ability to generalize findings becomes questionable when sample are selected on the bases of convenience. The characteristics of such samples may not accurately reflect the population they are supposed to represent. Cochran (1953) contends,

"The people from whom data are obtained, the sample, are of interest only insofar as the data tell us something about some larger group of people whom statisticians call the population or universe. Further, results obtained from a sample can be extended to a larger population with logical soundness only if the sample is, in a certain technical sense, a probability sample drawn from that population."

Samples selected on bases of convenience are not necessarily a probability sample drawn from the populations under study. Without any indications that selected samples represent the studied populations, researchers are generalizing the findings on their studies.

2. Practitioners and Users as Respondents

A total of 49 questionnaires, interviews, and observations were used as data collection instruments. Humans either responded to or were the subjects observed for all of these instruments. Practitioners and users of information systems were the focus of 43 of these 49 instruments. The remaining 6 instruments involved students. The high proportion of studies involving practitioners and users of information systems, rather than college students,

enhanced the ability to generalize the findings of the studies onto operational situations.

3. Insufficient Information Concerning Sample Size

The researchers failed to provide information clearly identifying the number of samples, duration of sampling, or frequency of collections for 27 of the 65 instruments. The absence of such information prevents readers from fully assessing how well samples represented the studied populations.

4. Insufficient Information Concerning Response Rates

The questionnaires and interviews used in the 37 studies all relied upon respondent participation. The representativeness of samples collected with these instruments is affected by the response rates achieved. The researchers failed to provide information regarding the response rates achieved for 20 of the 40 questionnaires and interviews. The absence of such information prevents evaluation of how well the samples represented the studied populations.

5. Distribution of Questionnaires by Mail

The researchers failed to provided information identifying how 18 of the 36 questionnaires used were distributed. Mail was the most common method of distribution, used for 15 of the 36 questionnaires. The researchers that mailed questionnaires were vulnerable to persons other than the identified respondents having

completed the questionnaires. Without face-to-face interaction, it is difficult to know who completes a questionnaire. Because the researchers do not know for certain the identities of the respondents, the representative of the samples becomes suspect.

6. Few Researchers Discuss Non-Respondents

The researchers failed to discuss differences between respondents and non-respondents for 30 of the 40 instruments involving questionnaires or interviews. The failure to identify differences precluded readers from assessing whether the researchers had addressed issues regarding respondent biases. The absence of discussions of differences between respondents and non-respondents raised doubts concerning the representativeness of almost all samples.

D. HANDLING OF VALIDITY ISSUES

1. Few Researchers Address Internal Validity Issues

The researchers acknowledged deficiencies regarding the internal validity of six of the 65 data instruments. The acknowledgements of such deficiencies indicates that the researchers responsible for the six involved studies were aware and sensitive to internal validity issues.

The researchers asserted another eight of the 65 instruments demonstrated internal validity. The assertions of internal validity indicates that the researchers

responsible for the eight involved studies were also aware and sensitive to internal validity issues.

Sufficient discussions of internal validity were not presented for the overwhelming majority of instruments. The researchers failed to present discussions of internal validity for 46 of the 65 instruments. Their discussions for the remaining five instruments cited secondary sources which provided little evidence supporting internal validity.

In all, 51 of the 65 instruments used in the 37 studies were not accompanied by adequate discussions of internal validity. Instruments are not considered to have demonstrated validity unless sufficient evidence is presented to support such claims. None of these 51 instruments can be considered to have demonstrated internal validity. All of the researchers who used these instruments based their findings upon measures that have not demonstrated internal validity. This raises a question as to whether these researchers, most of those involved in the 37 studies, ignored internal validity issues or were simply not aware of them.

2. Few Researchers Address External Validity Issues

The researchers acknowledged deficiencies regarding the external validity of six of the 65 instruments. The acknowledgements of such deficiencies indicates that the researchers responsible for the six involved studies were aware and sensitive to external validity issues.

The researchers responsible for four studies presented or cited discussions which asserted that their instruments had demonstrated external validity. Clearly, they were aware and sensitive to external validity issues.

Without having provided discussions of external validity issues, the researchers generalized the findings of studies which were based upon data from six of the 65 instruments. The absence of explicit discussions of external validity issues indicates that these researchers, responsible for seven of the studies, either ignored or were unaware of external validity issues.

Sufficient discussions of external validity were not presented for the overwhelming majority of data collection instruments. The researchers failed to present discussions of external validity for another 43 of the 65 instruments. Their discussions regarding the remaining six instruments cited secondary sources which provided little evidence supporting external validity.

In all, 55 of the 65 instruments used in the 37 studies were not accompanied with adequate discussions of external validity. None of these 55 instruments can be considered to have demonstrated external validity. All of the researchers who used these instruments based their findings upon measures that have not demonstrated external validity. This raises a question as to whether these researchers, most of those involved in the 37 analyzed

studies, ignored external validity issues or were simply not aware of them.

3. Few Researchers Identify Specific Types of Validity

Researchers claimed or implied that 15 instruments demonstrated validity. Specific types of validity were identified for five instruments that were claimed to have demonstrated validity. The four studies, which used these instruments, identified combinations of the following specific types of validity: internal, external, content, construct, discriminant-convergent, and criterion. These were the only researchers who comprehensively confronted validity issues, having both claimed and identified specific types of validity. These researchers were aware of the different types of validity.

The remaining ten data collection instruments were implied to have demonstrated validity. Their studies included no discussions which directly identified specific types of validity, rather they implied individual instruments had demonstrated internal and or external validity. Readers can only guess whether these researchers were aware of the different types of validity.

4. Few Researchers Identify the Sources of Claimed or Implied Validity

Researchers claimed or implied that 15 instruments demonstrated validity. Researchers responsible for the four studies, which claimed that five instruments demonstrated validity, identified analyses of instrument measures as their sources of validity. These researchers openly stated that the measures from their individual instruments served as the sources for claims of validity. Readers can investigate these sources to substantiate the claims of validity, enhancing the credibility of the studies.

The remaining ten data collection instruments were implied to have demonstrated validity. None of the ten studies involving these instruments identified sources of validity. The absence of cited sources precludes readers from substantiating the implied validity of these instruments, detracting from the credibility of the studies.

5. Inadequacy of Collectively Addressing Validity Issues

Eighteen studies used multiple data collection instruments. In 14 of these studies, researchers presented discussions that addressed validity issues in a collective manner. Such discussions provided no information regarding the validity of individual instruments, rather they solely addressed the collective validity of the entire studies.

Although discussions regarding collective validity were interesting to read, they were essentially meaningless in the absence of discussions that substantiated the validity individual instruments. Without having presented evidence that the individual instruments have demonstrated validity, researcher can not reasonably expect to claim or imply collective validity for entire studies.

Many researchers appear to have mistakenly believed that discussions of only collective validity adequately addressed validity issues. Researchers often presented discussions of only collective validity in their studies. Only two of the 14 studies included discussions of both individual and collective validity. The absence of discussions substantiating the validity of individual instruments, necessitates that claims of collective validity be discounted for the 12 studies that included discussions of only collective validity.

E. RECOMMENDATIONS

A minority of researchers addressed validity issues. Discussions regarding the validity of data collection instruments were generally superficial. Rarely did researchers demonstrate awareness or sensitivity to validity issues. Most researchers appear to have expected unquestioned acceptance of their findings, since readers were provided with relatively few discussions of validity. Such expectations are inappropriate in scientific research.

The failure to discuss validity issues detracts from the credibility of research involving the information systems discipline.

An emphasis on validity issues should be encouraged throughout the information systems discipline. Students, practitioners, and researchers must be made acutely aware and sensitive to the concept of validity. Implementation of the following suggestions would heighten awareness and sensitivity:

1. Students should receive exposure to the concept of validity as part of their graduate school instruction.
2. Practitioners should implement the recommendations resulting from only studies that discussed and demonstrated validity.
3. Professional journals pertaining to the information systems discipline should require that all articles submitted by researchers include discussions of validity issues.

Information systems researchers have adopted the data collection instruments commonly found in social science research, yet have largely failed to face-up to the validity issues that inherently arise with their use. Social scientists have long understood and addressed validity issues. Information systems researchers should confront validity issues in the same manner as social scientists. They must become aware of the threats to validity and develop experimental designs which enhance both internal and external validity. They must clearly and comprehensively

discuss validity issues, adding credibility to information systems research.

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APPENDIX A

ANALYZED STUDIES

- Colton, K. W., "Computers and Police: Patterns of Success and Failure," *Sloan Management Review*, Vol. 14, No. 2, (Winter 1972-73), pp. 75-98.
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APPENDIX B

DETAILED ANALYSIS OF STUDIES

Colton, K. W., "Computers and Police: Patterns of Success and Failure," *Sloan Management Review*, Vol. 14, No. 2, (Winter 1972-73), pp. 75-98.

Description of System Studied: Information systems used by police departments. Applications included police patrol and daily operations; investigative analysis; administration and management; and program, planning, and evaluation.

Data Collection Technique(s) Used: All respondents completed questionnaire. Selected respondents were later interviewed.

Characteristics of Measuring Instruments Used: Specific characteristics of the measuring instruments were not explicitly discussed. The survey was devised by the International City Management Association, appearing not to have complied with an established format. No formal questionnaire was administered, but an effort was made to ask a common set of questions--an unstructured and scheduled interview.

Objective(s) of Measurement Process: Questionnaires were aimed at documenting the growth, extent, and impact of computers used by police departments. Interviews were aimed at evaluating questions on impact, effectiveness, and success. Data collected were not specifically identified as measures of attitude, opinion, behavior, or etc..

Participants in Measurement Process: Police chiefs and data processing managers of police departments in cities with populations of over 25,000.

Distribution of Measuring Instruments: Questionnaires were mailed to all police departments in cities with populations of over 50,000 and to 25% of cities with populations between 25,000 and 50,000. A total of 498 questionnaires were mailed and 376 responses were received (75.5%). Interviews were personally conducted at 14 police departments. Visits of 3 to 4 days were conducted at 9 police departments and brief contacts were made in 5 other departments. A total of

143 interviews were conducted with law enforcement personnel.

Corrective Action taken to Account for Non-participants:

Second mailings to cities that failed to respond were made.

Identification of Differences between Participants and Non-participants: Not discussed.

Method Used to Analyze Data: Method of data analysis not stated.

Issue of Validity Addressed: Not discussed.

Type of Validity Claimed: Not discussed.

Source of Validity Claimed: Not discussed.

Type of Data Recorded: Qualitative, Metric, Interval, Frequency, and Ordinal.

Powers, R. F. and G. W. Dickson, "MIS Project Management: Myths, Opinions and Reality," *California Management Review*, Vol. 15, No. 3, (1973), pp. 147-156.

Description of System Studied: Twenty management information systems used in the manufacturing, wholesale and retail trade, transportation, finance, utility, and commodity merchandising and processing businesses.

Data Collection Technique(s) Used: Questionnaire for initially identifying factors affecting MIS project success. Subsequent interview and questionnaire to research correlates of success with MIS projects.

Characteristics of Measuring Instruments Used: The questionnaire used to initially identify factors affecting MIS project success required the respondent to rank the importance of 35 factors, as selected by 25 MIS experts, on a five point scale. Only the average time spent during each interview was provided, 9 hours per firm. No information was provided pertaining to the second questionnaire, beyond the fact that it was pretested.

Objective(s) of Measurement Process: Determine what organizational and procedural factors are correlates of success with MIS projects. The questionnaire used to initially identify factors affecting MIS project success was acknowledged as measuring beliefs. Data collected in interviews and with second questionnaire were not specifically identified as measuring beliefs, attitudes, behavior, or etc..

Participants in Measurement Process: Initial questionnaire was given to MIS experts attending the Founding Conference of the Society for Management Information Systems at the University of Minnesota in 1969. The interviews and second questionnaires were used to study 10 firms, with each providing 2 MIS projects, in the Minneapolis and St. Paul area. The respondents within the firms were directors of MIS, project leaders, computer operating personnel, and management users.

Distribution of Measuring Instruments: The initial questionnaire was given to the respondents. The interview and second questionnaire was conducted on-site, at the firms. Response rates were not discussed.

Corrective Action taken to Account for Non-participants:
Not discussed.

Identification of Differences between Participants and Non-participants: Not discussed.

Method Used to Analyze Data: Data were analyzed using non-parametric statistical techniques, specifically Kendall's tau statistic.

Issue of Validity Addressed: "Kendall's tau statistic was chosen for the data analysis because of its statistical properties which facilitated testing the various hypotheses for significance." The ability to generalize findings was briefly discussed (External validity).

Type of Validity Claimed: External validity, the authors stated that in their opinions their findings could be generalized to MIS projects.

Source of Validity Claimed: Not discussed.

Type of Data Recorded: Qualitative, Metric, Interval, and Frequency.

Lucas, H. C., Jr., "System Quality, User Reactions and The Use of Information Systems," *Management Informatics*, Vol. 3, No. 4, (1974), pp. 207-212.

Description of System Studied: Twenty-six separately identifiable batch computer systems at a major university. These systems are concerned with accounting, student record keeping, purchasing, fund raising, alumni record keeping, etc..

Data Collection Technique(s) Used: Two questionnaires.

Characteristics of Measuring Instruments Used: The first questionnaire was similar in structure to those used in past studies, the majority of responses have a range from one to seven. The second questionnaire was a structured questionnaire.

Objective(s) of Measurement Process: The first questionnaire measured user attitudes toward information services department activities and perceptions of the quality of information systems service were measured. The second questionnaire dealt with the quality of systems as seen by users.

Participants in Measurement Process: The first questionnaire was completed by 117 administrative users of the 26 systems at the major university. The second questionnaire was completed by staff members in operations and systems design positions. The second questionnaire was completed by between 1 and 3 staff members in the information services department, on each of the 26 systems.

Distribution of Measuring Instruments: Methods of distribution were not discussed. An adjusted response rate of 70% for those distributed was claimed for the first questionnaire. No response rate was discussed for the second survey.

Corrective Action taken to Account for Non-participants:
Not discussed.

Identification of Differences between Participants and Non-participants: Not discussed.

Method Used to Analyze Data: Step-wise multiple regression used to analyze the data.

Issue of Validity Addressed: The author discussed extension of study: "The research techniques and instruments in this study can be used by any organization to evaluate its information systems. This study has demonstrated an association between systems quality and user reactions to information systems.... Though causality has not been demonstrated, *a priori* arguments and data support the goals of developing favorable user attitudes and high quality systems to encourage use of information systems."

Type of Validity Claimed: External validity through argument of extension.

Source of Validity Claimed: *A priori* arguments and data.

Type of Data Recorded: Ordinal.

Secondary Source(s) Cited: Lucas (1973) is where the original questionnaire was presented, however, its validity was not clearly established.

Swanson, E. B., "Management Information Systems: Appreciation and Involvement," *Management Science*, Vol. 21, No. 2, (October 1974), pp. 178-188.

Description of System Studied: An activity reporting system (MIS) used by a 200 employee department of a large international manufacturer of complex electronic equipment. The system gathers data on the planned and actual work activity of the department's members, and makes it available to management on a "need to know" basis.

Data Collection Technique(s) Used: Analysis of existing documents and records and questionnaire.

Characteristics of Measuring Instruments Used: Computer logs were the archival data analyzed. The questionnaire consisted of a set of 16 items, based upon an arbitrary 0.0 to 1.0 scale range, subdivided into five intervals, assumed to be equal. The respondent checked an interval. The questionnaire consisted of a set of 10 items, based upon a frequency range.

Objective(s) of Measurement Process: Archival data used to measure system usage. The research questionnaire was constructed to obtain indicators of MIS appreciation and a priori involvement. Data collected in questionnaire was not specifically identified as measuring beliefs, attitudes, behavior, or etc..

Participants in Measurement Process: Users of the system.

Distribution of Measuring Instruments: Method of distribution appears to have been mail. Of the 46 questionnaires distributed, 37 were returned.

Corrective Action taken to Account for Non-participants: Not discussed.

Identification of Differences between Participants and Non-participants: Not discussed.

Method Used to Analyze Data: Simple classification and non-parametric analysis of data.

Issue of Validity Addressed: "It should be noted, however, that the direction of the original causal argument has not been tested... no controlled experimentation was undertaken in this study.... In short, there is no beginning for a causal argument." Later, "The single case presented here does not permit effective generalization."

Type of Validity Claimed: None.

Source of Validity Claimed: Not discussed.

Type of Data Recorded: Ordinal and frequency (using an ordinal scale).

Gallagher, C. A., "Perceptions of the Value of a Management Information System," *Academy of Management Journal*, Vol. 17, No. 1, (March 1974), pp. 46-55.

Description of System Studied: A management information system used for cost accounting. It was developed in 1967/68 and used by a company employing 1,800 people, of whom 375 were management personnel.

Data Collection Technique(s) Used: Questionnaire.

Characteristics of Measuring Instruments Used: Questionnaire consists of two parts. The first part solicited an opinion expressed in dollar values. The second part solicited an opinion reported by scoring fifteen bipolar adjective pairs on a seven-point scale.

Objective(s) of Measurement Process: The study was used to determine the value of an existing set of MIS reports. The study measures user perceptions.

Participants in Measurement Process: Managers using reports generated by the system.

Distribution of Measuring Instruments: The questionnaire was mailed to 103 managers, of which 75 usable replies were received.

Corrective Action taken to Account for Non-participants: Not discussed.

Identification of Differences between Participants and Non-participants: Not discussed.

Method Used to Analyze Data: Semantic differential results and correlation between value measures were used to analyze the data.

Issue of Validity Addressed: "The principal challenge lies in designing questions which will minimize the effects of bias and inaccuracy in user perceptions.... This study included one test of a new methodology. The results of a single test cannot establish the validity of a methodology, although they can discredit all or part of the methodology.... A question may be raised regarding the use of hypothetical questions. Do the answers to a hypothetical question bear any relationship to those that would be obtained in an actual situation? Surely the answers would not be identical."

Type of Validity Claimed: None

Source of Validity Claimed: Study identified lack of validity.

Type of Data Recorded: Interval and ordinal.

Lucas, H. C., Jr., "Performance and The Use of an Information System," *Management Science*, Vol. 21, No. 8, (April 1975a), pp. 908-919.

Description of System Studied: An information system used to provide sales activity data for a major manufacturer of ready-to-wear clothing.

Data Collection Technique(s) Used: Analyses of existing records and documents and questionnaire.

Characteristics of Measuring Instruments Used: Computer records and personnel files are the existing records used in the study. The questionnaires employed scales ranging from 1 to 5 or 1 to 7.

Objective(s) of Measurement Process: The goals of the study was to determine the variables influencing sales force performance and the use of a sales information system and to determine if a relationship exists between the use of the system and performance. Data collected by analyses of computer files measures performance and situation. Data collected by analyses of personnel records measures personal variables. Data collected by the questionnaires were measures of usage, attitudes, and perceptions.

Participants in Measurement Process: Members of the sales force (salesmen and account executives).

Distribution of Measuring Instruments: Distribution method unknown. A questionnaire was administered to the 439 members of the sales force; approximately a 90% return rate was achieved (316 salesmen and 82 account executives).

Corrective Action taken to Account for Non-participants: One follow-up.

Identification of Differences between Participants and Non-participants: Not discussed.

Method Used to Analyze Data: Step-wise multiple regression analysis was used to analyze the data.

Issue of Validity Addressed: "It is difficult to draw conclusions about causality from cross-sectional studies. Both laboratory studies with their superior controls and field studies are needed to confirm and expand the findings reported here."

Type of Validity Claimed: None.

Source of Validity Claimed: Not discussed.

Type of Data Recorded: Ordinal and other unknown.

Lucas, H. C., Jr., "The Use of Accounting Information System, Action and Organizational Performance," *Accounting Review*, (October 1975b), pp. 735-746.

Description of System Studied: Information system used by a major California bank with more than 200 branches in the state. The information system was used to generate accounting information.

Data Collection Technique(s) Used: Analyses of existing records and documents and questionnaires.

Characteristics of Measuring Instruments Used: Computer files were used for analyses of existing records and documents. Questionnaires employed scales.

Objective(s) of Measurement Process: The goals of the study were to determine what variables are associated with branch performance and specify what variables are associated with action and the use of the accounting information system. Data obtained from computer files were used to measure performance and situation. Questionnaires were used to measure attitude.

Participants in Measurement Process: A questionnaire was administered to managers and assistant managers in 165 branches in three geographic divisions of the bank. Another questionnaire was administered to division managers.

Distribution of Measuring Instruments: The questionnaire completed by branch managers and assistant managers was mailed. A 96% return rate was achieved for managers and a 95% return rate was achieved for assistant managers. Distribution and response rate of questionnaire administered to the division managers is unknown.

Corrective Action taken to Account for Non-participants:
Not discussed.

Identification of Differences between Participants and Non-participants: Not discussed.

Method Used to Analyze Data: Step-wise multiple regression was used to analyze the data in the study.

Issue of Validity Addressed: Factor analysis and correlation coefficients were used to determine if items could be combined in a single scale during the development of the questionnaire. "In a field study it is difficult to obtain good measures for operationalized variables and to control for confounding variables. The lack of extremely strong results can be partially attributed to errors in measuring the variables which were included in the research."

Type of Validity Claimed: None.

Source of Validity Claimed: None.

Type of Data Recorded: Ordinal and unknown other(s).

Secondary Source(s) Cited: Lucas (1973) is where the original questionnaire was presented, however, its validity was not clearly established.

Hall P. G. and T. J. Lincoln, "A Cost Effectiveness Study of Production and Engineering Systems within a Tightly Integrated Manufacturing Environment," *Management Datamatics*, Vol. 5, No. 6, (1976), pp. 262-274.

Description of System Studied: Production and engineering computer systems in the Commercial Aircraft Division of British Aircraft Corporation. Applications involving product definition, work in progress, and supplies management were performed on these systems.

Data Collection Technique(s) Used: Participant observation and interviews.

Characteristics of Measuring Instruments Used: The study began with a two days of observing the system in question and interviewing the senior systems analyst. One primary user of each system was interviewed for 1 to 2 hours. User management was interviewed after receiving documentation resulting from the primary user interview. It was made clear that the user management interview would form the basis for further discussions with senior management. A final presentation and interview of senior management was conducted prior to presentation of results to the company's board.

Objective(s) of Measurement Process: Interview with the senior system analyst provided computer cost and background information regarding system. Interview with primary users identified user costs and the impact of the system on the user's department. Interview of user management provided costs and benefits information. Presentation and interview of senior management was aimed at informing management of results and ironing out any difficulties or uncertainties which still existed. Data collected were not specifically identified as measurements of attitudes, opinion, behavior, or etc..

Participants in Measurement Process: Senior systems analysts, one primary user of each system (as identified by its senior systems analyst), user management, and senior management.

Distribution of Measuring Instruments: All interviews appear to have been conducted in person.

Corrective Action taken to Account for Non-participants: Not discussed.

Identification of Differences between Participants and Non-participants: Not discussed.

Method Used to Analyze Data: Method of data analysis not stated.

Issue of Validity Addressed: Essentially stated that other companies should conduct similar studies and generalizes its findings.

Type of Validity Claimed: External (implied).

Source of Validity Claimed: Not discussed.

Type of Data Recorded: Interval, metrics, and unknown others.

Schewe, C. D., "The Management Information System User: An Exploratory Behavioral Analysis," *Academy of Management Journal*, Vol. 19, No. 4, (December 1976), pp. 577-590.

Description of System Studied: Eight batch and two interactive systems of ten food processing firms in three midwestern states.

Data Collection Technique(s) Used: Questionnaire and possible analysis of existing records and documents.

Characteristics of Measuring Instruments Used: Questionnaire used a five-point, bipolar scale. No details regarding how system usage (monthly requests) were measured.

Objective(s) of Measurement Process: "This study focused on attitudes toward use of the information system." "System usage in this study was measured by the number of monthly requests that a manager/system user made for additional information." "A behavioral study utilizing an attitudinal model explored the relationships between MIS users' perceptions of their computer system, perceived variables exogenous to the system, attitudes, and system usage."

Participants in Measurement Process: Middle managers (41 batch system users and 38 interactive system users).

Distribution of Measuring Instruments: Not discussed.

Corrective Action taken to Account for Non-participants: Not discussed.

Identification of Differences between Participants and Non-participants: Not discussed.

Method Used to Analyze Data: Data were analyzed by the use of step-wise regression.

Issue of Validity Addressed: "This study was exploratory, and the attitude variables studied are not completely comprehensive of the system user's attitude system toward usage of the MIS."

Type of Validity Claimed: None.

Source of Validity Claimed: Not discussed.

Type of Data Recorded: Ordinal.

Edström, A., "User Influence and the Success of MIS Projects: A Contingency Approach," *Human Relations*, Vol. 30, No. 7, (1977), pp. 589-607.

Description of System Studied: Systems designed to support management decision-making, selected from sixteen companies. All companies were located in the Paris region of France. The companies were involved in manufacturing, transportation, and service industries.

Data Collection Technique(s) Used: Interviews.

Characteristics of Measuring Instruments Used: Structured interviews with four key players in each organization. The interview questions have been of both the open ended and fixed alternative answer kind. A seven point rating scale was used.

Objective(s) of Measurement Process: "It should be pointed out, however, that the measures of outcomes are perceptual measures rather than assessments based on objective criteria." The data were measures of perceptions.

Participants in Measurement Process: System development manager, functional manager, project manager, and a user.

Distribution of Measuring Instruments: Personal interviews.

Corrective Action taken to Account for Non-participants:
Not discussed.

Identification of Differences between Participants and Non-participants: Not discussed.

Method Used to Analyze Data: Spearman-rank correlation coefficients were used to analyze the data.

Issue of Validity Addressed: "There are several weaknesses in the proposed design that need mentioning. First, we are relying on people's memories for data on the system-development process.... A second weakness in our design is the fact that we have to rely on the perceptions of people instead of making direct observations.... Third, our results are limited to the particular roles in the development process that we studied. Application to systems development in general must be made with caution, since we only have one informant per group."

Type of Validity Claimed: None.

Source of Validity Claimed: Not discussed.

Type of Data Recorded: Ordinal.

King, W. R. and J. I. Rodriguez, "Evaluating Management Information Systems," *Management Information System Quarterly*, Vol. 2, No. 3, (September 1978), pp. 43-51.

Description of System Studied: A system designed to aid managers in understanding and resolving competitor-related strategic issues. It was a system that combined an intelligent management information system and a management decision support system.

Data Collection Technique(s) Used: Experiment using a questionnaire.

Characteristics of Measuring Instruments Used: Experiment conducted in a simulated business environment. True experiment, pre/post test and post test only, control group design. Questionnaire was developed by Schultz and Slevin, employing ordinal scale.

Objective(s) of Measurement Process: The questionnaire assessed attitudes and value perceptions.

Participants in Measurement Process: Forty-five experienced manager-users, who were enrolled in part-time MBA program.

Distribution of Measuring Instruments: Questionnaire given to students participating in MBA program.

Corrective Action taken to Account for Non-participants: Not discussed.

Identification of Differences between Participants and Non-participants: Not discussed.

Method Used to Analyze Data: Methods used to analysis data were Schultz-Slevin "dependent variables", Kendall Rank Correlation test, and possible regression.

Issue of Validity Addressed: "Clearly, behavior in the simulated business environment in which the evaluation was performed may not be closely related to behavior in the real world which may raise questions as to the external validity of the experiment."

Type of Validity Claimed: None.

Source of Validity Claimed: Not discussed.

Type of Data Recorded: Ordinal.

Secondary Source(s) Cited: Schultz and Slevin (1975) is where the development of the original instrument was presented, however, its validity was not clearly established.

Elchesen, D. R., "Cost-Effectiveness Comparison of Manual and On-line Retrospective Bibliographic Searching," *Journal of American Society for Information Science*, Vol. 29, No. 2, (March 1978), pp. 56-66.

Description of System Studied: Manual and on-line bibliographic information. Forty search queries were processed against seven abstracting-indexing publications and the corresponding SDC/ORBIT data base.

Data Collection Technique(s) Used: Experiment relying on observation of participants.

Characteristics of Measuring Instruments Used: Participants measured variables of interest and recorded results on logs. Participants assigned values to the effectiveness of the search results.

Objective(s) of Measurement Process: Measures of performance were implied. Data collected were not specifically identified as measures of attitude, opinion, behavior, or etc..

Participants in Measurement Process: Eight of thirteen members of the Lawrence Livermore Laboratory Research Information Group. The group was charged with providing bibliographic information service to the Laboratory's scientific and engineering staff. All were experienced with manual and on-line bibliographic searching.

Distribution of Measuring Instruments: Not discussed.

Corrective Action taken to Account for Non-participants: Not discussed.

Identification of Differences between Participants and Non-participants: Not discussed.

Method Used to Analyze Data: Descriptive statistics were used to analyze the data.

Issue of Validity Addressed: Researchers generalize results of study.

Type of Validity Claimed: External (implied).

Source of Validity Claimed: Not discussed.

Type of Data Recorded: Qualitative and metric.

Robey, D. and R. L. Zeller, "Factors Affecting the Success and Failure of an Information System for Product Quality," *Interfaces*, Vol. 8, No. 3, (February 1978), pp. 70-75.

Description of System Studied: Quality information system used by the product quality section of two neighboring plants of a division of a very large U.S. corporation. The divisions manufactured a wide variety of highly technical equipment of the health care industry.

Data Collection Technique(s) Used: Interview, supplemental questionnaire, analysis of existing records and documents, and interviews.

Characteristics of Measuring Instruments Used: No information regarding the conduct of the interview. Company documents were used during the analysis of existing documents and records. Questionnaire was developed by Schultz and Slevin.

Objective(s) of Measurement Process: Interviews gathered general information about the implementation process in each department. The interview and company documents were used to identify some differences in structure between the departments. Questionnaires measured attitudes. "Responses show the user's perceptions of how favorable the system is for each area of concern."

Participants in Measurement Process: Eleven users.

Distribution of Measuring Instruments: Not discussed.

Corrective Action taken to Account for Non-participants: Not discussed.

Identification of Differences between Participants and Non-participants: Not discussed.

Method Used to Analyze Data: Mann-Whitney U test was used to analyze the data.

Issue of Validity Addressed: "While we cannot say that attitudes were the cause of behavior in this case, certain attitudes, and not others, are related to behavior." "The essential advantage of our research design is its ability to compare attitudes, organization structure and implementation process while holding the MIS features, production technology and corporate policy constant. By controlling the effects of these other factors, the effects of the behavioral and organizational factors can be more readily

identified."

Type of Validity Claimed: External (implied).

Source of Validity Claimed: Not discussed.

Type of Data Recorded: Ordinal.

Secondary Source(s) Cited: Schultz and Slevin (1975) is where the development of the original instrument was presented, however, its validity was not clearly established.

Lucas, H. C., Jr., "Unsuccessful Implementation: The Case of a Computer-Based Order Entry System," *Decision Sciences*, Vol. 9, No. 1, (January 1978), pp. 68-79.

Description of System Studied: Optical character recognition system and keypunch system for order entry procedures conducted in two divisions of a large West Coast apparel manufacturing company.

Data Collection Technique(s) Used: Experiment and questionnaire

Characteristics of Measuring Instruments Used: Experiment employed a control group and examined the implementation of a system in a longitudinal field study. The questionnaire used scaled variables from 1 to 7. Modified version of the JDI work scale was used to measure satisfaction.

Objective(s) of Measurement Process: Questionnaire measures success of implementation, costs, and benefits.

Participants in Measurement Process: Sales representatives.

Distribution of Measuring Instruments: Distribution to the experimental group (approximately 120 sales representative) is unknown. Questionnaires were mailed to the control group of 70 randomly selected sales representatives. Approximately three months later a follow-up questionnaire was mailed. Response to the second questionnaire was 56 for the experimental group and 58 for the control group.

Corrective Action taken to Account for Non-participants: Not discussed.

Identification of Differences between Participants and Non-participants: Not discussed.

Method Used to Analyze Data: Dynamic and cross-lagged correlational analysis was employed.

Issue of Validity Addressed: "The quasi-experimental research design and these statistical techniques provided increased confidence about causal inferences concerning the relationship between the benefits and costs of the new system and successful implementation."

Type of Validity Claimed: Internal (implied).

Source of Validity Claimed: Not discussed.

Type of Data Recorded: Ordinal.

Secondary Source(s) Cited: Smith, Kendall, and Hulin (1969) present original instrument and established its validity.

Neumann, S. and E. Segev, "A Case Study of User Evaluation of Information Characteristics for Systems Improvement," *Information & Management*, Vol. 2, (1979), pp. 271-278.

Description of System Studied: A computerized information system which served 148 branches of one of the three leading banks in Israel.

Data Collection Technique(s) Used: Interview and questionnaire were administered jointly.

Characteristics of Measuring Instruments Used: The interview was unstructured and scheduled. A 1 to 5 scale was used in the questionnaire.

Objective(s) of Measurement Process: The data were measures of the respondents perceptions.

Participants in Measurement Process: Branch managers.

Distribution of Measuring Instruments: Interviews conducted in person. Questionnaires were provided by hand to 130 branch managers. Eighty-one sets of interviews and questionnaires were properly completed and returned by mail.

Corrective Action taken to Account for Non-participants: Not discussed.

Identification of Differences between Participants and Non-participants: Not discussed.

Method Used to Analyze Data: Guttman's correlation coefficients of weak monotonicity.

Issue of Validity Addressed: "We believe the findings may have implications for other organizations.... The findings have no implications on the *a priori* users' definitions of their needs, only on perceptions of existing systems.... Further research in other organizations,... is necessary to validate whether the findings of this study are unique or typical of other organizations."

Type of Validity Claimed: None.

Source of Validity Claimed: Not discussed.

Type of Data Recorded: Ordinal.

Robey, D., "User Attitudes and Management Information System Use," *Academy of Management Journal*, Vol. 22, No. 3, (September 1979), pp. 527-538.

Description of System Studied: Computer based system to record, update, and maintain information pertaining to customer sales accounts. The system was used by sales members of a large industrial products manufacturer.

Data Collection Technique(s) Used: Analysis of existing documents and records and questionnaire.

Characteristics of Measuring Instruments Used: Two kinds of account records were the existing documents and reports used. A Schultz and Slevin type of questionnaire was used. Both a five point and a ten point scale was used in the questionnaire.

Objective(s) of Measurement Process: Account records were analyzed to measure system usage. The questionnaire measured users' attitudes.

Participants in Measurement Process: Members of the sales force.

Distribution of Measuring Instruments: Corporate mail was used for distribution and a 100% return rate was achieved.

Corrective Action taken to Account for Non-participants: Not required.

Identification of Differences between Participants and Non-participants: No non-participants.

Method Used to Analyze Data: Cronbach's coefficient alpha, Spearman rank correlations, and Pearson product-moment correlations.

Issue of Validity Addressed: "In returning to the more direct implications of this research, it is important to note its limitations. First, although the Schultz and Slevin instrument appears to be superior to single-item scales used elsewhere, it has not received extensive validation.... Second, a word of caution must be extended to those interpreting these results and the results of any cross-sectional study. Strong positive relationships have been demonstrated between specific user attitudes and actual use of an MIS. It does not necessarily follow, however, that attitudes cause behavior."

Type of Validity Claimed: None.

Source of Validity Claimed: Not discussed.

Type of Data Recorded: Ordinal, frequency, and interval.

Secondary Source(s) Cited: Schultz and Slevin (1975) is where the development of the original instrument was presented, however, its validity was not clearly established.

Mansour, A. H. and H. J. Watson, "The Determinants of Computer Based Information System Performance," *Academy of Management Journal*, Vol. 23, No. 3, (September 1980), pp. 521-533.

Description of System Studied: Computer based information systems in engineering, finance, manufacturing, retail/wholesale, service, and government.

Data Collection Technique(s) Used: Two questionnaires.

Characteristics of Measuring Instruments Used: User questionnaire used a five point scale. Expert questionnaire was used for design of experiment.

Objective(s) of Measurement Process: Questionnaire completed by users obtained data on behavioral, structural, environmental, and performance variables. Questionnaires completed by experts identified study variables and assigned weights to the variables.

Participants in Measurement Process: Users and expert panel (three practitioners and three academicians in the CBIS field).

Distribution of Measuring Instruments: Unknown quantity of user questionnaires were mailed. A total of 108 questionnaires were returned. Distribution of expert questionnaire is unknown.

Corrective Action taken to Account for Non-participants: Not discussed.

Identification of Differences between Participants and Non-participants: Not discussed.

Method Used to Analyze Data: Step-wise regression.

Issue of Validity Addressed: Author implies internal validity and external validity.

Type of Validity Claimed: Internal and external (implied).

Source of Validity Claimed: Not discussed.

Type of Data Recorded: Ordinal, qualitative, and interval.

Ball, L. D., "Increasing the Manager's Productivity Through the Information System," *Public Productivity Review*, Vol. 4, No. 1, (March 1980), pp. 51-62.

Description of System Studied: Reporting and retrieval software system that facilitated the specification and retrieval of data existing or derived from available, perhaps multiple, computer files.

Data Collection Technique(s) Used: Analysis of existing documents and reports and questionnaire.

Characteristics of Measuring Instruments Used: Report requests were the documents and reports analyzed. Questionnaires type was not discussed.

Objective(s) of Measurement Process: Reports were analyzed to measure system usage. Apparently, the questionnaire solicited opinions of the managers concerning the system. Data collected were not specifically identified as measures of attitude, opinion, behavior, or etc...

Participants in Measurement Process: Managers who were users of the system were interviewed.

Distribution of Measuring Instruments: Not discussed beyond stating that the sample was very small.

Corrective Action taken to Account for Non-participants: Not discussed.

Identification of Differences between Participants and Non-participants: States possible reasons some managers were non-users of the system, thus making them non-participants in the study.

Method Used to Analyze Data: Descriptive statistics.

Issue of Validity Addressed: Not discussed.

Type of Validity Claimed: Not discussed.

Source of Validity Claimed: Not discussed.

Type of Data Recorded: Qualitative, Metric, Interval, and Frequency.

Edelman, F., "Managers, Computer Systems, and Productivity," *Management Information System Quarterly*, Vol. 5, No. 3, (September 1981), pp. 1-19.

Description of System Studied: Industrial Relations Information System at RCA, used to provide MIS support relating to human resource management. The system included data base, interactive, office support, and management support technologies.

Data Collection Technique(s) Used: Controlled experiment and apparently analysis of existing records and documents.

Characteristics of Measuring Instruments Used: Experiment employed a target and control group. Apparently archival records pertaining to personnel costs were used during the experiment.

Objective(s) of Measurement Process: Apparently the data collected measured costs.

Participants in Measurement Process: Fourteen of RCA's eighteen operating units.

Distribution of Measuring Instruments: Not discussed.

Corrective Action taken to Account for Non-participants: None required.

Identification of Differences between Participants and Non-participants: Clearly identified.

Method Used to Analyze Data: Descriptive statistics.

Issue of Validity Addressed: Only the validity of the experimental design used.

Type of Validity Claimed: Not discussed.

Source of Validity Claimed: Not discussed.

Type of Data Recorded: Interval and frequency.

Altmeyer, A. S. and L. S. Bozeman, "Productivity via Computer Technology," *Public Productivity Review*, Vol. 5, No. 4, (December 1981), pp. 321-334.

Description of System Studied: Welfare Management System, an information system designed to receive and process information on clients who have applied for or have been determined eligible for public assistance. Medicaid Management Information System, an information system designed to improve the availability of health care services as well as administrative controls over rising costs.

Data Collection Technique(s) Used: Interviews and two questionnaires. Interviews and first questionnaire was used to design experiment.

Characteristics of Measuring Instruments Used: A series of open-ended, unstructured field interviews. Semi-structured six-question telephone questionnaire, which asked open-ended questions regarding performance benefits. Survey questionnaire was self-administered, containing 102 questions. The questionnaire required the respondent to select "agree, do not know, or disagree" for statements. It was reviewed by a panel of experts, before administration.

Objective(s) of Measurement Process: "Responses (of survey questionnaires) showed perceptual judgements of middle management...." Author presents findings gathered from survey data regarding managerial aspects; productivity; organizational effectiveness; and several user attitudes.

Participants in Measurement Process: Interviews were conducted with personnel serving in several levels of county social services departments. Additional interview were held with a number of county commissioners as well as officials at the state office in Albany. The telephone questionnaire was administered to county staff developmental personnel. Survey questionnaire was administered to various levels of managers.

Distribution of Measuring Instruments: Interviews were conducted in person, no response rate was provided. Telephone questionnaire was administered over the telephone, with 44 of 56 staff development coordinators responding. Survey questionnaires were mailed to 492 managers, with a response rate of 67%.

Corrective Action taken to Account for Non-participants:
Not discussed.

Identification of Differences between Participants and Non-participants: Not discussed.

Method Used to Analyze Data: Descriptive statistics.

Issue of Validity Addressed: Results of study were generalized.

Type of Validity Claimed: External (implied).

Source of Validity Claimed: Not discussed.

Type of Data Recorded: Qualitative.

Ginzberg, M. J., "Early Diagnosis of MIS Implementation Failure: Promising Results and Unanswered Questions." *Management Science*, Vol. 27, No. 4, (April 1981), pp. 459-478.

Description of System Studied: On-Line Portfolio Management system, an information system used to support portfolio managers in their job of managing asset portfolios consisting primarily of common stock, debt instruments, and cash. The system was operated in the trust department of a large U.S. bank.

Data Collection Technique(s) Used: Interview, two questionnaires, and analysis of existing documents and records.

Characteristics of Measuring Instruments Used: Interview used to develop pre-implementation questionnaire. Pretest of the pre-implementation questionnaire was conducted. Pre-implementation questionnaire consisted of open-ended questions. Post-implementation questionnaire used closed-ended questions and scales questions. Post-implementation analysis of existing documents and records was collected by systems software to measure system individual system usage.

Objective(s) of Measurement Process: Author stated that three major types of data were collected: 1) users' pre-implementation expectations, 2) expert group pre-implementation expectations and 3) users' post-implementation assessment of success. Post-implementation data were collected to measure attitudes and behavior. Attitudes were measured by questionnaire and behavior by archival records.

Participants in Measurement Process: Interviews to develop pre-implementation questionnaire were conducted with a sample of portfolio managers (15%), system developers (both internal and external), trust department management, and other trust department personnel. Pre-implementation questionnaire was administered to portfolio managers and others. Post-implementation questionnaire was administered to portfolio managers who had responded to the pre-implementation questionnaire.

Distribution of Measuring Instruments: Interviews appear to have been conducted in person. Pre-implementation interview was mailed to 44 portfolio managers and 21 others, with 86% and 82% response rates achieved respectively. Post-implementation interview was mailed to the portfolio managers and a 82% response rate was achieved.

Corrective Action taken to Account for Non-participants: Follow-up message.

Identification of Differences between Participants and Non-participants: Differences were discussed. "Analysis of the available data shows no significant, nor even sizable, difference between respondents and non-respondents on pre-implementation demographic or attitudinal measures."

Method Used to Analyze Data: Pre-implementation expectation data were analyzed using McQuitty's Elementary Linkage Analysis. Post-implementation data were analyzed using Kendall's tau correlations.

Issue of Validity Addressed: "While there is no *a priori* reason to believe that the specific characteristics of this situation limit the generalizability of the results, there is also no evidence to support such generalizations."

Type of Validity Claimed: Limited external (implied).

Source of Validity Claimed: None.

Type of Data Recorded: Ordinal and frequency.

Cron, W. L. and M. G. Sobol, "The Relationship Between Computerization and Performance: A Strategy for Maximizing the Economic Benefits of Computerization," *Information & Management*, Vol. 6, No. 3, (June 1983), pp. 171-181.

Description of System Studied: Computers used by independent wholesalers involved in the medical supply industry.

Data Collection Technique(s) Used: Questionnaire.

Characteristics of Measuring Instruments Used: Not specifically discussed.

Objective(s) of Measurement Process: "The 1979 survey (questionnaire) was selected for analysis because it contained relevant computer usage information not in other editions." Data collected were not specifically identified as measuring of attitude, opinion, behavior, or etc..

Participants in Measurement Process: Wholesalers that responded to the annual financial and operating survey sponsored by the American Surgical Trade Association.

Distribution of Measuring Instruments: Distribution is unknown. A total of 138 wholesalers responded, achieving a 90% response rate.

Corrective Action taken to Account for Non-participants: Not discussed.

Identification of Differences between Participants and Non-participants: Major non-participants identified and differences discussed.

Method Used to Analyze Data: Descriptive statistics, Chi-square analysis, and analysis of variance.

Issue of Validity Addressed: "Though it is always difficult to establish causality from correlation data conclusively, a number of significant relationships were found.... While recognizing that it is important to replicate this study using different kinds of firms and industries, results of this study indicate that computerization is positively related to the overall performance of medium and larger size firms."

Type of Validity Claimed: External (implied).

Source of Validity Claimed: Not discussed.

Type of Data Recorded: Qualitative, Interval, and possible others.

Bruwer, P .J .S., "A Descriptive Model of Success for Computer-Based Information Systems," *Information & Management*, Vol. 1, No. 2, (July 1984), pp. 63-67.

Description of System Studied: 140 computerized systems, used by about 1200 clerical staff and 114 managers, in a very large organization.

Data Collection Technique(s) Used: Questionnaire.

Characteristics of Measuring Instruments Used: Most of the questions used a 7 point scale.

Objective(s) of Measurement Process: Questionnaire quantified variables in a model, and these variables were used to measure attitude, quality, success of system, and management involvement.

Participants in Measurement Process: Managers.

Distribution of Measuring Instruments: Not discussed. Full participation of 114 managers.

Corrective Action taken to Account for Non-participants: Not required, full participation.

Identification of Differences between Participants and Non-participants: Not required, full participation.

Method Used to Analyze Data: Using BMDP statistical computer, correlation and regression methods were used.

Issue of Validity Addressed: Generalized the results of his study.

Type of Validity Claimed: External (implied).

Source of Validity Claimed: Not discussed.

Type of Data Recorded: Ordinal.

Decker, J. E. and J. P. Plumlee, "Microcomputers, Manpower and Performance in a Public Utility," *Public Productivity Review*, Vol. 9, No. 2-3, (Summer/Fall 1985), pp. 213-225.

Description of System Studied: A work force management system, operated by the Jacksonville Electric Authority.

Data Collection Technique(s) Used: Analysis of existing documents and reports.

Characteristics of Measuring Instruments Used: Data base information was analyzed as existing documents and reports.

Objective(s) of Measurement Process: Measurement of performance.

Participants in Measurement Process: Case study of one utility company's experience.

Distribution of Measuring Instruments: Not discussed.

Corrective Action taken to Account for Non-participants: Not discussed.

Identification of Differences between Participants and Non-participants: Not discussed.

Method Used to Analyze Data: Descriptive statistics.

Issue of Validity Addressed: Generalized results. Implied external validity. Did not address internal validity.

Type of Validity Claimed: External (implied).

Source of Validity Claimed: Not discussed.

Type of Data Recorded: Metric, Interval, and Frequency.

Englander, V. and F. Englander, "Cost-Effectiveness of Computer-Based Welfare Fraud Detection in New Jersey," *Public Productivity Review*, Vol. 9, No. 2-3, (Summer/Fall 1985), pp. 271-282.

Description of System Studied: Software program which was used to detect the fraudulent receipt of public assistance benefits by participants in the Aid to Families with Dependent Children, the Food Stamps, and the Medicaid programs of New Jersey.

Data Collection Technique(s) Used: Analysis of existing records and documents.

Characteristics of Measuring Instruments Used: Computer records were analyzed quarterly to match SSN of welfare recipients against employed taxpayers.

Objective(s) of Measurement Process: Data were used to measure cost savings. The value was determined by keeping a running total of reductions in benefits directly from closures and grant reductions detected by computer matches.

Participants in Measurement Process: New Jersey Division of Public Welfare.

Distribution of Measuring Instruments: Not discussed.

Corrective Action taken to Account for Non-participants: Assumed full participation.

Identification of Differences between Participants and Non-participants: Assumed full participation.

Method Used to Analyze Data: Regression analysis.

Issue of Validity Addressed: Addressed possible problems with the internal validity. External validity was not discussed.

Type of Validity Claimed: Not discussed.

Source of Validity Claimed: Not discussed.

Type of Data Recorded: Interval.

Sullivan, R. S. and S. C. Secrest, "A Simple Optimization DSS for Production Planning at Dairyman's Cooperative Creamery Association," *Interfaces*, Vol. 15, No. 5, (September-October 1985), pp. 46-53.

Description of System Studied: A small optimization-based decision support system that was used to perform milk flow analysis at Dairyman's Cooperative Creamery Association.

Data Collection Technique(s) Used: Analysis of existing documents and reports.

Characteristics of Measuring Instruments Used: Reports generated by the milk flow analysis program were the existing documents and reports analyzed.

Objective(s) of Measurement Process: Reports generated by the milk flow program were analyzed to measure system performance.

Participants in Measurement Process: Several plant supervisors who had been involved with production planning for more than 20 years.

Distribution of Measuring Instruments: Not discussed.
Response rate was not discussed.

Corrective Action taken to Account for Non-participants:
Not discussed.

Identification of Differences between Participants and Non-participants: Not discussed.

Method Used to Analyze Data: Not discussed.

Issue of Validity Addressed: Not discussed.

Type of Validity Claimed: Not discussed.

Source of Validity Claimed: Not discussed.

Type of Data Recorded: Interval and metric.

Lincoln, T., "Do Computer Systems Really Pay-off?,"
Information & Management, Vol. 11, No. 1, (August 1986), pp.
25-34.

Description of System Studied: Systems consisting of 167 individual applications, ran by 20 companies. These applications reside on integrated systems, stand-alone systems, and general facility/service systems.

Data Collection Technique(s) Used: Analysis of existing documents and records, interview, and questionnaire.

Characteristics of Measuring Instruments Used: Existing documents and records were archival data such as accounting reports. Each interview was customized and incorporates a questionnaire. The participant reviewed and signed-off on the results of the interview.

Objective(s) of Measurement Process: Analyses of existing documents and records were a measure of costs. Interviews and questionnaires were used to identify (measure) benefits.

Participants in Measurement Process: Users.

Distribution of Measuring Instruments: Distribution of existing documentation was not discussed. Interview and questionnaire appears to have been administered in person. Response rate was not discussed.

Corrective Action taken to Account for Non-participants:
Not discussed.

Identification of Differences between Participants and Non-participants: Not discussed.

Method Used to Analyze Data: Descriptive statistics and financial analysis techniques (break-even point, mean benefit/cost ratio, and internal rates of return.

Issue of Validity Addressed: The author addressed unreliability of user interviews.

Type of Validity Claimed: Not discussed.

Source of Validity Claimed: Not discussed.

Type of Data Recorded: Interval, Frequency, and possible others.

Franz, C.R. and D. Robey, " Organizational Context, User Involvement, and the Usefulness of Information Systems," *Decision Sciences*, Vol. 17, No. 3, (Summer 1986), pp. 329-355.

Description of System Studied: Information systems used by 34 organizations. The types and modes of interaction varied greatly between systems.

Data Collection Technique(s) Used: Interview and questionnaire.

Characteristics of Measuring Instruments Used: Characteristics of the interview were not discussed. A cross-sectional field survey. Questionnaire was Likert type.

Objective(s) of Measurement Process: The interviews yielded a preliminary view of its computer and information system. Questionnaire was used to measure user's involvement and perceived usefulness of system.

Participants in Measurement Process: Initial interviews were with senior MIS managers. Questionnaires were completed by user-managers.

Distribution of Measuring Instruments: Of the 49 managers contacted for interviews, 44 agreed to cooperate. Distribution of the questionnaire was not discussed. A total of 188 user-managers in 34 organizations returned the questionnaire. The response rate was not discussed.

Corrective Action taken to Account for Non-participants: Not discussed.

Identification of Differences between Participants and Non-participants: Not discussed.

Method Used to Analyze Data: Canonical correlation models were constructed using Statistical Package for Social Sciences, release 7.0 to analyze data.

Issue of Validity Addressed: Authors stated that standardized instruments for measuring user involvement and system usefulness were unavailable at the start of the study. They had to develop and validate an approach to measure such variables. They clearly described how the questionnaire instrument was developed and tested. Imply

that the external validity of their instruments have not been established.

Type of Validity Claimed: Internal (implied).

Source of Validity Claimed: Not discussed.

Type of Data Recorded: Ordinal.

Kapsales, P., "Before and After WP: An Office Automation Productivity Study," *Journal of Systems Management*, Vol. 37, No. 4, (April 1986), pp. 7-9.

Description of System Studied: Word processing system used by a major division of a State government.

Data Collection Technique(s) Used: Analysis of existing documents and records.

Characteristics of Measuring Instruments Used: Archival data were used as existing documents and records to collect data.

Objective(s) of Measurement Process: Data were used to measure cost.

Participants in Measurement Process: A major division of a State government.

Distribution of Measuring Instruments: Not discussed.

Corrective Action taken to Account for Non-participants: Not discussed.

Identification of Differences between Participants and Non-participants: Not discussed.

Method Used to Analyze Data: Descriptive statistics.

Issue of Validity Addressed: Presented as one-shot case study, but provides a few generalizations for other organizations.

Type of Validity Claimed: External (implied).

Source of Validity Claimed: Not discussed.

Type of Data Recorded: Interval.

Snitkin, S.R. and W. R. King, "Determinants of the Effectiveness of Personal Decision Support Systems," *Information & Management*, Vol. 10, No. 2, (January 1986), pp. 83-89.

Description of System Studied: Personal decision support systems.

Data Collection Technique(s) Used: Questionnaire.

Characteristics of Measuring Instruments Used:
Questionnaire used a five point scale and open-ended questions.

Objective(s) of Measurement Process: Questionnaire measured user perception of system effectiveness and the open-ended question allowed users to describe the most important applications pertaining to effectiveness.

Participants in Measurement Process: Users of personal decision support systems, purchased from one vendor.

Distribution of Measuring Instruments: Questionnaires were mailed to 310 users. A response rate of 18% was achieved.

Corrective Action taken to Account for Non-participants:
Not discussed.

Identification of Differences between Participants and Non-participants: "The respondent anonymity requested by the computer deal precluded an analysis of non-respondents."

Method Used to Analyze Data: Chi-square analysis.

Issue of Validity Addressed: Not addressed.

Type of Validity Claimed: Not discussed.

Source of Validity Claimed: Not discussed.

Type of Data Recorded: Qualitative, ordinal, and possible others.

Aldag, R. J. and D. J. Power, "An Empirical Assessment of Computer Assisted Decision Analysis," *Decision Sciences*, Vol. 17, No. 14, (Fall 1986), pp. 572-588.

Description of System Studied: DECAID, a first-generation computerized decision-analysis program. The program helped the user conduct a structured decision analysis, using question-and-response dialogues.

Data Collection Technique(s) Used: Experiment and questionnaire.

Characteristics of Measuring Instruments Used: Experiment was conducted in the laboratory. Questionnaire was Likert type, using five and seven point scales.

Objective(s) of Measurement Process: Experiment was used to introduce post-test control group into design. The questionnaire measured attitudes.

Participants in Measurement Process: Business students in undergraduate and graduate level normative decision-making courses.

Distribution of Measuring Instruments: Assumed to have been distributed in class.

Corrective Action taken to Account for Non-participants: Not discussed.

Identification of Differences between Participants and Non-participants: Not discussed.

Method Used to Analyze Data: Variety of methods used to analyze correlation (Principal component factor analysis with varimax rotation, analysis of inter rater reliability, Dimensional interactive cognitive complexity, tolerance for ambiguity,... and one-way analysis of variance.)

Issue of Validity Addressed: Internal validity was strongly implied and authors directly addressed face validity of program. "In conclusion, computerized decision-analysis aids may serve many useful functions. However, the only benefits clearly evident at present are that the programs offer students experience with a new decision technology and provide a structured experience in decision making. These programs seem to have high face validity and may result in positive user affect and enhanced confidence." External validity was addressed, "Clearly, additional studies are needed before confident prescriptions can be made concerning

the applicability and benefits of computerized decision aids for management decision making."

Type of Validity Claimed: Internal.

Source of Validity Claimed: Analysis of instrument measures.

Type of Data Recorded: Ordinal.

Baroudi, J. J., M. H. Olson and B. Ives, "An Empirical Study of the Impact of User Involvement on System Usage and Information Satisfaction," *Communications of the ACM*, Vol. 29, No. 3, (March 1986), pp. 232-238.

Description of System Studied: A variety of information systems in over 200 large manufacturing firms.

Data Collection Technique(s) Used: Questionnaire.

Characteristics of Measuring Instruments Used:

Questionnaire developed and partially validated by Bailey and Pearson.

Objective(s) of Measurement Process: Measures of information satisfaction, system usage, and user involvement.

Participants in Measurement Process: Production managers from over 200 large manufacturing firms.

Distribution of Measuring Instruments: A total of 800 questionnaires were mailed, with 200 subjects responding.

Corrective Action taken to Account for Non-participants: Not discussed.

Identification of Differences between Participants and Non-participants: Briefly mentioned that old mailing lists were used, trying to account for non-response.

Method Used to Analyze Data: Zero order correlations were calculated, a correlation matrix developed, and path coefficients calculated.

Issue of Validity Addressed: "Data generated in this study were also used to further validate and modify this instrument." "Even though the data were collected in a cross-sectional survey, attention was paid to the causal ordering of the variables." "Generalizability across organizations and systems was enhanced by including over 200 users in the same function from many different organizations." "Perceptual rather than objective measures of system usage were utilized." Authors clearly addressed internal and external concerns in their conclusions.

Type of Validity Claimed: None.

Source of Validity Claimed: Analysis of instrument measures.

Type of Data Recorded: Ordinal.

Secondary Source(s) Cited: Bailey and Pearson (1983) is where the development of the original instrument was presented. Its validity was discussed, claiming content, construct, and external validity. The source of the claim was an analysis of the instruments measurements.

Franz, C. R., D. Robey and R. R. Koebnitz, "User Response to an Online Information System: A Field Experiment," *Management Information Systems Quarterly*, (March 1986), pp. 29-42.

Description of System Studied: Patient Care System, developed jointly by the Duke University Medical Center and IBM, as operated in a large hospital with over 400 beds, delivering more than 150,000 patient days of health care.

Data Collection Technique(s) Used: Experiment and two questionnaires.

Characteristics of Measuring Instruments Used: A quasi-experimental research design was employed in a field study, using a separate-sample pretest-post-test design as described by Campbell and Stanley. Job perceptions were measured using Job Characteristics Inventory developed by Sims, Szilagyi, and Keller. User attitudes were measured using five point Likert type instrument developed by Schultz and Slevin.

Objective(s) of Measurement Process: Questionnaire used to collect perceptual and attitudinal data.

Participants in Measurement Process: Nurses.

Distribution of Measuring Instruments: Random selection of participating nurses with 258 completing the pretest questionnaire and 218 completing the post-test questionnaire.

Corrective Action taken to Account for Non-participants: Not discussed.

Identification of Differences between Participants and Non-participants: Dropouts from experiment were studied to make suggestions regarding differences between participants and non-participants.

Method Used to Analyze Data: Data were analyzed using the Statistical Package for the Social Sciences Version H, Release 9.0.

Issue of Validity Addressed: "The design (experiment) did, however, permit an assessment of the effects of the pretest on post-test scores, a common threat to internal validity in experimental design." Authors addressed external validity.

Type of Validity Claimed: None.

Source of Validity Claimed: Analysis of instrument measures.

Type of Data Recorded: Ordinal.

Secondary Source(s) Cited: Schultz and Slevin (1975) presented the original instrument, however, its validity was not clearly established.

Sims, Szilagyi, and Keller (1976) presented analysis of original instrument (Job Characteristic Inventory) and claimed to have demonstrated construct and discriminant-convergent validity. The source of the claim was an analysis of the instruments measures.

Durand, D. E., R. O. Bennett and S. Betty, "What Did Information Technology 'Do' to Business Communications?: Two Empirical Studies," *Information & Management*, Vol. 13, No. 3, (October 1987), pp. 111-117.

Description of System Studied: Enable, a word processing software package.

Data Collection Technique(s) Used: Experiment using participant observation.

Characteristics of Measuring Instruments Used: Observations of written output and speed of reading were recorded and analyzed.

Objective(s) of Measurement Process: Observations measured writing style and content and speed of reading.

Participants in Measurement Process: Students in an introductory information systems course were observed to measure writing style and content. Business professionals were observed to measure speed of reading.

Distribution of Measuring Instruments: A total of 79 students participated. It was assumed that the observations were made in the student's class. Full participation of students is assumed. Distribution to business professionals was not discussed, nor were their response rates.

Corrective Action taken to Account for Non-participants: Assumed full participation of students. Not discussed with business professionals.

Identification of Differences between Participants and Non-participants: Assumed full participation of students. Not discussed with business professionals.

Method Used to Analyze Data: Observations (the written output of students) was analyzed using Quintilian Analysis, a computer program specifically designed to analyze writing style and content. Non-parametric statistical procedures (Mann-Whitney U for ordinal data) and parametric statistics for ratio data. Descriptive statistics were used to analyze the reading speed data.

Issue of Validity Addressed: Not discussed. Internal and external validity are implied in findings.

Type of Validity Claimed: Internal (implied) and External (implied).

Source of Validity Claimed: Not discussed.

Type of Data Recorded: Interval and frequency.

Gallupe, R. B. and G. DeSanctis, "Computer-Based Support for Group Problem Finding: An Experimental Investigation," *Management Information System Quarterly*, Vol. 12 , No. 2, (June 1988), pp. 277-296.

Description of System Studied: DECAID, a group decision support system.

Data Collection Technique(s) Used: Experiment using a panel of three judges to compile observations, and two questionnaires.

Characteristics of Measuring Instruments Used: Experiment was of pre and post test design. The panel of three judges apparently assumed the role of complete observers; performing document analysis. All questionnaires used a seven point Likert scale. Interviews were conducted in a group setting.

Objective(s) of Measurement Process: Observations made by the three judges were measures of decision quality. The questionnaires and interviews measured group members' perceptions of group decision confidence and group satisfaction.

Participants in Measurement Process: Senior undergraduate business administration students. Random assignment of respondents to various experiment groups.

Distribution of Measuring Instruments: A total of 84 students participated in the study. No discussion of response rate was provided, it is assumed that this was part of a class assignment. All questionnaires and interviews were administered in person.

Corrective Action taken to Account for Non-participants: Assumed full participation.

Identification of Differences between Participants and Non-participants: Assumed full participation.

Method Used to Analyze Data: A fixed-effect two-way analysis of a variance model was applied to all dependent measures.

Issue of Validity Addressed: "All of these findings must be interpreted with caution, given the limited scope and sampling used in this study. As a controlled experimental study the findings cannot necessarily be generalized to all levels or types of GDSS software or to actual organizational use of GDSS technology."

Type of Validity Claimed: Internal (implied).

Source of Validity Claimed: Not discussed.

Type of Data Recorded: Qualitative and ordinal.

Tait, P. and I. Vessey, "The Effect of User Involvement on System Success: A Contingency Approach" *Management Information System Quarterly*, (March 1988), pp. 91-108.

Description of System Studied: 42 recently implemented custom-built information systems, within Australian firms.

Data Collection Technique(s) Used: Questionnaires.

Characteristics of Measuring Instruments Used: All questionnaires were either off-the-shelf or employed techniques used in previous studies.

Objective(s) of Measurement Process: Questionnaires administered to the users measured success of the system, user involvement in design, impact of the system on the organization, and the attitudes of the users. Questionnaires administered to the designers measured the technical complexity of the system and the resource constraints on the development of the system.

Participants in Measurement Process: Users and designers of the information systems.

Distribution of Measuring Instruments: A total of 84 system users and designers participated in the study, achieving a 71 percent response rate. Questionnaires were sent by mail.

Corrective Action taken to Account for Non-participants: Follow-up phone calls.

Identification of Differences between Participants and Non-participants: Not discussed.

Method Used to Analyze Data: Path analysis.

Issue of Validity Addressed: "Data for the study were collected after the systems were implemented. Subjects' responses may have been influenced by the ultimate success or failure of the systems. The timing of the data collection may have had a secondary influence on the measurement of user attitudes.... A further limitation of the study is the use of instruments that are not sufficiently validated--the perennial problem of a new discipline."

Type of Validity Claimed: None.

Source of Validity Claimed: None.

Type of Data Recorded: Ordinal and possible others.

Secondary Source(s) Cited: Questionnaire was comprised of subsections, using instruments developed by Wolek (1975), Elizur and Guttman (1976), Ein-Dor and Segev (1978), Keen (1981), McFarlan (1981), Ives, Olson, and Baroudi (1983).

Discussions of validity were presented in Elizur and Guttman (1976) and Ives et al. (1983). None of the other discussions significantly substantiate the validity of this study.

Cronan, T. P. and D. E. Douglas, "End-User Training and Computing Effectiveness in Public Agencies: An Empirical Study." *Journal of Management Information Systems*, Vol. 6, No. 4, (Spring 1990), pp. 21-39.

Description of System Studied: End user computing systems of an overall public agency involved in financial services.

Data Collection Technique(s) Used: Two questionnaires and analysis of existing documents and records.

Characteristics of Measuring Instruments Used:

Questionnaire administered to users completing the training program used a five point scale (Not focus of study). Separate questionnaires administered to end users and supervisors use a five point type scale and are shortened versions of previously used instruments in other studies. Existing documents and records were agency statistics.

Objective(s) of Measurement Process: Questionnaires measured training program, EUC effectiveness, and end user acceptance/satisfaction.

Participants in Measurement Process: Over 100 public personnel, predominately accountants. Users completing the training program evaluated the training program. End users and supervisors measured end user computing effectiveness and end user acceptance/satisfaction.

Distribution of Measuring Instruments: A total of 39 responses were used to evaluate the training program, distribution and response rate was not discussed.

Corrective Action taken to Account for Non-participants: Not discussed.

Identification of Differences between Participants and Non-participants: Not discussed.

Method Used to Analyze Data: Paired t-test statistic, Chi Square test statistic, partied t-test statistic, Wilcoxon signed rank test statistic.

Issue of Validity Addressed: Explained types of validity and presented argument that sufficient degree of correlation exist to claim reliability, convergent, and construct validity. Advised caution should be exercised in complete generalizations of the results.

Type of Validity Claimed: Convergent and construct.

Source of Validity Claimed: Results of correlation analysis.

Type of Data Recorded: Ordinal, interval, frequency, and possible others.

Secondary Source(s) Cited: Baroudi and Orlikowski (1988), Doll and Torkzadeh (1988), and Ives, Olson, and Baroudi (1983) are where the development of the original instruments were presented. Its validity was discussed by all the above authors, claiming construct, convergent-discriminant, and criterion validity. The source of the claims are analyses of measurements from the instrument.

APPENDIX C

CONSOLIDATED ANALYSIS OF STUDIES

(Follows on succeeding pages.)

STUDY	YEAR	INSTRUMENT USED	INSTRUMENT CHARS.	PURPORTED MEASURE	RESPONDENTS	N	RESPS RATE	DISTR METHOD	FOLLOW UP	DISC DIFF P VS NP	ADDRESS I-VALID	ADDR E-VALID	VALIDITY CLAIMED	SOURCE VALIDITY
Colton	72	Questionnaire	Not disc	System	Police chiefs & DP personnel	376	75.5%	Mail	Second Mailing	Not disc	Not disc	Not disc		
		Interview	Unstructured & unscheduled	System	Police chiefs & DP personnel	143	Not disc	Admin in person	Not disc	Not disc	Not disc	Not disc		
Powers & Dickson	73	Questionnaire	Ordinal scale	Attitude	MIS experts	140	Not disc	Admin in person	Not disc	Not disc	Not disc	Not disc		
		Interview	Not Disc	System	MIS personnel & managers	Unclear	Not disc	Admin in person	Not disc	Not disc	Not disc	Not disc		
		Questionnaire	Not disc	System	MIS personnel & managers	Unclear	Not disc	Not disc	Not disc	Not disc	Not disc	Not disc		
COLLECTIVELY														
Lucas	74	Questionnaire	Ordinal scale	Attitude	Users	117	70%	Not disc	Not disc	Not disc	Not disc	Rel 2nd	External	Not disc
		Questionnaire	Structured Unclear scaling	System	Staff members	Unclear	Unclear	Not disc	Not disc	Not disc	Not disc	Not disc		
COLLECTIVELY														
Swanson	74	Questionnaire	Ordinal scale	Attitude & Behavior	Users of system	37	80.4%	Not disc	Not disc	Not disc	Not disc	Not disc	Generalized results	External Analysis of first measures
		Archival	Computer file Inquiry history file	Behavior	All inquiries 30 days prior						Not disc	Not disc		
COLLECTIVELY														
Gallagher	74	Questionnaire	Ordinal scale & specific value	Attitude	Managers	75	72.6%	Mail	Not disc	Not disc	None	None	None	None
Lucas	75a	Questionnaire	Ordinal scale	Attitude & Behavior	Salesmen & managers	398	90%	Not disc	One follow-up	Not disc	Not disc	Not disc		
		Archival	Computer records Sales info files	Situation		Not disc					Not disc	Not disc		
		Archival	Personnel files Employee records	Situation		Not disc					Not disc	Not disc		
COLLECTIVELY														
Lucas	75b	Questionnaire	Ordinal scale	Situation Behavior & Attitude	Managers & asst. managers	Unclear	96% 95%	Mailed	One follow-up	Not disc	Rel 2nd Not disc	Rel 2nd Not disc		
		Questionnaire	Ordinal scale	Situation	Division managers	Not disc	Not disc	Mailed	Not disc	Not disc	Not disc	Not disc		
		Archival	Computer files Bank's IS	Situation		Not disc					Not disc	Not disc		
COLLECTIVELY														
					Problems						Unproven	Lacks	None	
											Rel 2nd	Rel 2nd		

STUDY	YEAR	INSTRUMENT USED	INSTRUMENT CHARS.	PURPOSED MEASURE	RESPONDENTS	N	RESPS RATE	DISTR METHOD	FOLLOW UP	DISC DIFF P VS NP	ADDRESS I-VALID	ADDR E-VALID	VALIDITY CLAIMED	SOURCE VALIDITY
Hall & Lincoln	76	Interview	Unclear	System	Primary system users	Not disc	Not disc	Admin in person	Not disc	Not disc	Not disc	Not disc		
		Interview	Unclear	System	Senior system analysts	Not disc	Not disc	Admin in person	Not disc	Not disc	Not disc	Not disc		
		Observation	Participant as Observer	System	Senior managers	Not disc	Not disc		Not disc	Not disc	Not disc	Not disc		
COLLECTIVELY														
Schewe	76	Questionnaire	Ordinal scale	Attitude	Middle managers	79	Not disc	Not disc	Not disc	Not disc	Not disc	Generalized results	External (implied)	Not disc
		Unidentified		Behavior	Not disc	Not disc	Not disc	Not disc	Not disc	Not disc	Not disc	Variables in study not comprehensive	None	
COLLECTIVELY														
Edstrom	77	Interview	Structured Interval scale	Attitude	Managers & users	Not disc	Not disc	Admin in person	Not disc	Not disc	Weaknesses	Weaknesses	None	
King & Rodriguez	78	Questionnaire	Ordinal scale	Attitude	Students	48	Not disc	Not disc	Not disc	Not disc	Ref 2nd	Questions	None	
			Schultz & Slevin								Not disc	Ref 2nd	None	
Elchesen	78	Observation	Participant as Observer	System	Library researchers	8	61.5%		Not disc	Not disc	Not disc	Generalizes results	External (implied)	Not disc
Robey & Zeller	78	Interview	Not disc	Situation	Personnel in each department	Not disc	Not disc	Not disc	Not disc	Not disc	Not disc	Not disc		
Lucas		Questionnaire	Ordinal scale	Attitude	Users	11	Not disc	Not disc	Not disc	Not disc	Ref 2nd	Ref 2nd		
		Actual	Co. documents	Situation		Not disc					Not disc	Not disc		
			Org Charts								Problems w attitudes	Limited scope	External (implied)	Not disc
COLLECTIVELY														
Neumann & Segov	78	Questionnaire	Ordinal scale	System	Sales reps	114	63.4% (Random sample)	Mailed	Not disc	Not disc	Exp design	Not disc	Internal (implied)	Not disc
Neumann & Segov	79	Questionnaire	Ordinal scale	Attitude	Bank branch managers	81	62.3%	Mailed	Not disc	Not disc	Increased confidence	Ref 2nd	Discussed	
		Interview	Unstructured & scheduled	Attitude	Bank branch managers	81	62.3%	Admin in person	Not disc	Not disc	Not disc	Not disc		
											Not disc	Further study req	None	
COLLECTIVELY														

STUDY	YEAR	INSTRUMENT USED	INSTRUMENT CHARS.	PURPORTED MEASURE	RESPONDENTS	N	RESPS RATE	DISTR METHOD	FOLLOW UP	DISC DIFF P VS NP	ADDRESS I-VALID	ADDR E-VALID	VALIDITY CLAIMED	SOURCE VALIDITY
Robey	79	Archival	Computer files Customer records	Behavior		Not disc					Not disc	Not disc		
		Questionnaire	Ordinal scale Schultz & Stevin	Attitude	Members of sales force	66	100%	Corporate mail	Not disc	Not necessary	Ref 2nd Not disc	Ref 2nd Not disc		
COLLECTIVELY														
Mansour & Watson	80	Questionnaire	Ordinal scale	System Behavior & Situation	Users	108	Not disc	Mailed	Not disc	Not disc	Limits of study Implied	Tentative at best Implied	None	Int & ext (implied)
Bail	80	Archival	Not disc	Behavior		15 weeks of data					Not disc	Not disc		
Edelman	81	Questionnaire	Not disc	Not disc	User managers	Very small	Not disc	Not disc	Not disc	Not disc	Not disc	Not disc		
		Archival	Not disc	System		Not disc					Not disc	Not disc		
Almeyer & Bozeman	81	Questionnaire	Company records Ordinal scale	Attitude	managers	330	67%	Mailed	Not disc	Not disc	Not disc	Generalizes results	External (implied)	Not disc
Ginzberg	81	Questionnaire	Ordinal scale	Attitude	Portfolio managers	38	86%	Mailed	Follow-up message	Discussed	Not disc	Not disc		
		Questionnaire	Ordinal scale	Attitude	Bank personnel	17	82%	Mailed	Follow-up message	Discussed	Not disc	Not disc		
		Archival	Computer files	Behavior		Five month period					Not disc	Not disc		
		Questionnaire	Ordinal scale	Attitude	Portfolio managers	31	82%	Mailed	Not disc	Discussed	Not disc	Not disc		
COLLECTIVELY														
Cron & Sobol	83	Questionnaire	Not disc	System & Situation	Wholesalers of medical supplies	138	90%	Not disc	Not disc	Discussed	Not disc	Not disc	Limited external (implied)	Not disc
													Further studies required—Generalizes results	Not disc
Brower	84	Questionnaire	Ordinal scale	Attitude System Behavior & Situation	Managers	114	100%	Not disc	Not disc	Not necessary	Not disc	Generalizes results	External (implied)	Not disc
Decker & Plumlee	85	Archival	Database info Workload & Performance indicators	Situation		Not disc					Not disc	Generalizes results	External (implied)	Not disc

STUDY	YEAR	INSTRUMENT USED	INSTRUMENT CHARS.	PURPOSED MEASURE	RESPONDENTS	N	RESPS RATE	DISTR METHOD	FOLLOW UP	DISC DIFF P VS NP	ADDRESS I-VALID	ADDR E-VALID	VALIDITY CLAIMED	SOURCE VALIDITY
Englander & Englander	85	Archival	Computer files Wellfare & tax records	System		Not disc ran quarterly					ID possible problems	Not disc	Not disc	
Sullivan & Seacrest	85	Archival	Reports Computer generated	System		Not disc					Not disc	Not disc		
Lincoln	86	Archival	Reports Accounting	System		Not disc					Not disc	Not disc		
		Interview	Not disc	System	Users	Not disc	Not disc	Unclear	Not disc	Not disc	Mentions unreliability	Not disc		
Franz & Robey	86	Questionnaire Interview	Not disc Not disc	System Situation	Users Managers	Not disc 44	Not disc 89.8%	Unclear Not disc	Not disc Not disc	Not disc Not disc	Not disc Not disc	Not disc Not disc		
Kapsales	86	Questionnaire Archival	Ordinal scale Likert type WP documents	Attitude & Behavior System	User managers	188	Not disc	Not disc	Not disc	Not disc	Development & testing	Not established	Internal (implied)	Not disc
Satkin & King	86	Questionnaire	Ordinal scale & Open ended questions	Attitude System & Behavior	DSS users	56	18%	Mailed	Not disc	Discussed	Not disc	Not disc	Generalizes results (implied)	Not disc
Aldeg & Power	86	Questionnaire	Ordinal scale Likert type	Attitude	Students	88	Not disc	Not disc	Not disc	Not disc	How est'd	Further studies required	Internal	Analysis of inst measures
Baroudi, et al	86	Questionnaire	Ordinal scale Bailey & Pearson	Attitude Behavior & System	Production managers	200	25%	Mailed	Not disc	Discussed	Concerns & limits disc	Sample reps population disc	Content Construct External	Analysis of inst measures
Franz, et al	86	Questionnaire	Ordinal scale Likert type Sims, Szilagyi, Keller (JCI)	Attitude	Nurses	374 (random sample)	Not disc	Not disc	Not disc	Discussed	Rel 2nd discussed	Rel 2nd discussed	Construct discrim- convergent external	Analysis of inst measures
		Questionnaire	Ordinal scale Likert type Schultz & Sievin	Attitude	Nurses	374 (random sample)	Not disc	Not disc	Not disc	Discussed	Rel 2nd Not disc	Rel 2nd Not disc		
COLLECTIVELY														
Durand, et al	87	Observation	Participant as observer	System	Students	79	Not disc		Not disc	Not disc	Quasi-exp design	Generalizes results	Int & ext (implied)	Not disc
											Not disc	Not disc	Int & Ext (implied)	Not disc

STUDY	YEAR	INSTRUMENT USED	INSTRUMENT CHARS	PURPOSED MEASURE	RESPONDENTS	N	RESPS RATE	DISTR METHOD	FOLLOW UP	DISC DIFF P VS NP	ADDRESS I-VALID	ADDR E-VALID	VALIDITY CLAIMED	SOURCE VALIDITY
Gallupe & DeSanctis	88	Questionnaire	Ordinal scale Likert type	Attitude	Students	84	Not disc	Admin in person	Not disc	Not disc	Not disc	Not disc		
		Questionnaire	Ordinal scale Likert type	Attitude	Students	84	Not disc	Admin in person	Not disc	Not disc	Not disc	Not disc		
		Observation	Complete Observer	System	Students	84	Not disc		Not disc	Not disc	Not disc	Not disc		
COLLECTIVELY														
Tait & Vessey	88	Questionnaire	Ordinal scale Combines 6 Instr designs Likert type	System, Behavior Attitude & Situation	Users and designer of information systems	84	71%	Mailed	One by telephone	Not disc	Problems with Likert type scales. Problems with secondary influences. Instruments not sufficiently validated.	Implies not est'd	Internal (implied)	Not disc
Cronan & Douglas	90	Questionnaire	Ordinal scale Ives, et al. 1983	System & Behavior	End users	Unclear	Not disc	Not disc	Not disc	Not disc	discussed	discussed	Construct convergent-discrim criterion external	Analysis of Inst measures
		Questionnaire	Ordinal scale Ives, et al. 1983	System & Behavior	Supervisors of end users	Unclear	Not disc	Not disc	Not disc	Not disc	discussed	discussed	Construct convergent-discrim criterion external	Analysis of Inst measures
		Archival	Agency statistics	Situation		Not disc					Not disc	Not disc	Details, claims, & cautions generalize	Internal external construct convergent
COLLECTIVELY														

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